anatomy hand-out

ABDOMEN

BY

DR. SAMEH DOSS (Ph.D)

PROFESSOR OF ANATOMY
FACULTY OF MEDICINE, CAIRO UNIVERSITY

رقم الايداع بدار الكتب
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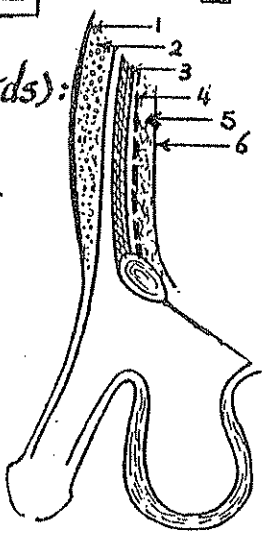
I.S.B.N.: 978 – 977 – 90 – 2544 - 5

Correspondence 01229129090

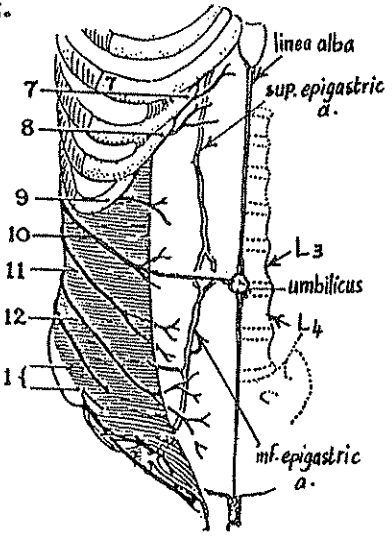
ANT. ABDOMINAL WALL



* **Structure:** it is formed of the following layers (from outside inwards):
  (1) skin (2) superficial fascia (3) abdominal muscles
  (4) fascia transversalis (5) extraperitoneal fatty tissue
  (6) parietal layer of peritoneum.

A- Skin of abdominal wall

* it is thin & presents:
  (1) pubic hairs: in females the hair is limited to the pubic region, in males a strip of hairs extends up to the umbilicus.
  (2) the umbilicus: lies in the centre of the ant. abdominal wall.

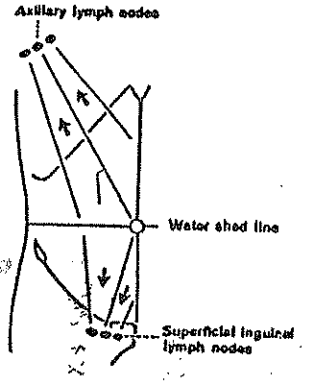


The Umbilicus

* **Definition:** it is a depressed wrinkled scar formed by the separation of the stump of the umbilical cord after birth.
* **Position:** it lies in the linea alba in the ant. middle line at the level of the disc between the 3rd & 4th lumbar vertebrae.
* **N. supply:** it is supplied by T10

* **Anatomical importance:**

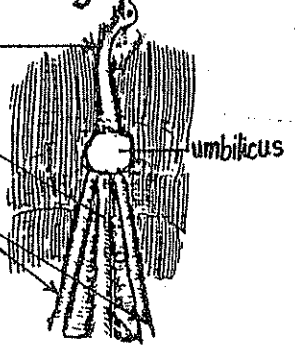
(1) the level of the umbilicus is called the "water shed line of the body" that marks the direction of the venous & lymphatic drainage of the ant. abdominal wall. Above the level of the umbilicus the lymph and venous blood pass upwards while below this level they pass downwards.



(2) the umbilicus is one of the sites of porto-caval anastomosis (p. 81).

(3) anastomosis between sup. & inf. epigastric arteries occurs at the level of the umbilicus.

(4) the post. surface of the umbilicus is the meeting point of 4 peritoneal ligaments:
  (a) ligamentum teres of liver (obliterated umbilical v. of the embryo).
  (b) median umbilical lig. (obliterated uracus of the embryo).
  (c) Rt. medial umbilical lig. } (obliterated umbilical aa. of ")
  (d) Lt. " " " }



(5) the umbilicus is the site of attachment of the umbilical cord during foetal life.

(B) Fascia of ant. abdominal wall

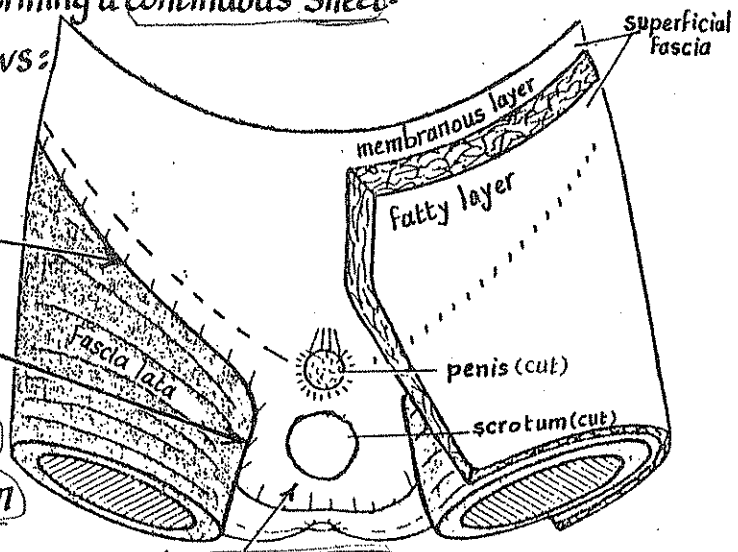
(1) There is no deep fascia in the ant. abdominal wall.

(2) The superficial fascia differentiates, particularly below the umbilicus, into 2 layers:

(A) Superficial fatty layer (Camper's fascia) which is continuous with the superficial fascia of the adjoining parts of the body.

(B) Deep membranous layer (Scarpa's fascia):

* it is well defined below the umbilicus forming a continuous sheet.
* its lower border is attached as follows:
  (1) lateral to each pubic tubercle: it is attached to the fascia lata of thigh a finger breadth below the inguinal lig.
  (2) medial to pubic tubercle: it is attached to the pubic arch & tubercle.
  (3) in the median plane it gives a tubular like envelope around the penis & scrotum then extends backwards into the perineum forming the Colle's fascia.



← يتظهر بس فتحة التناسل والشرج

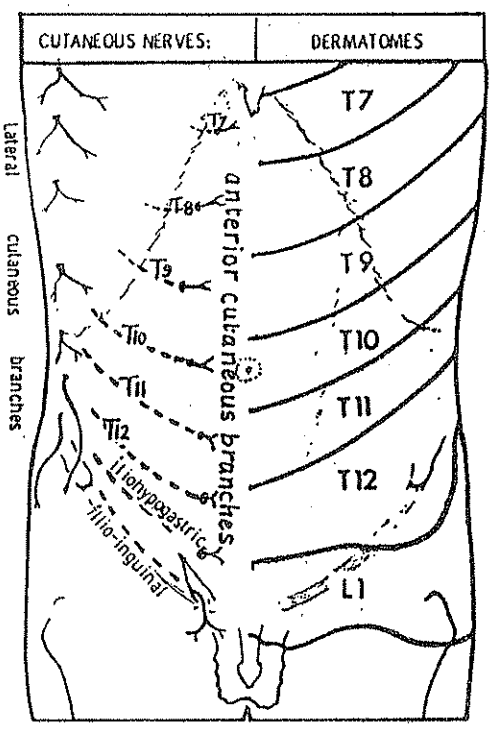
Cutaneous nerve supply of ant. abdominal Wall

The skin of the anterolateral abdominal wall is supplied segmentally by the lat. & ant. cutaneous branches of the lower 5 intercostal nn. (T7-11), the subcostal n. (T12), iliohypogastric & ilioinguinal nerves (L1) as follows:

(a) 3 nerves (T7,8,9) supply the skin segmentally from the level of the xiphoid process to the umbilicus.

(b) T10 supplies the segment of skin at the level of the umbilicus.

(c) 3 nerves (T11, 12 & L1) supply the skin segmentally from the level of the umbilicus to the inguinal region.



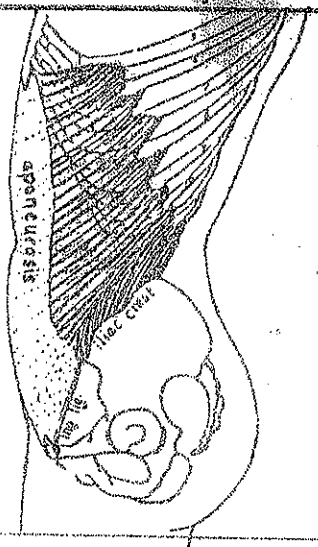
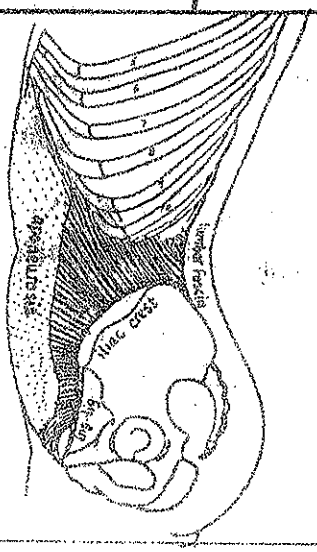
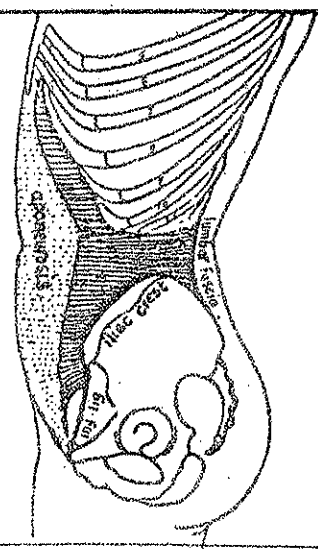
Muscles of the anterolateral abdominal wall

the muscles of the anterolateral abdominal wall are classified into 2 groups :

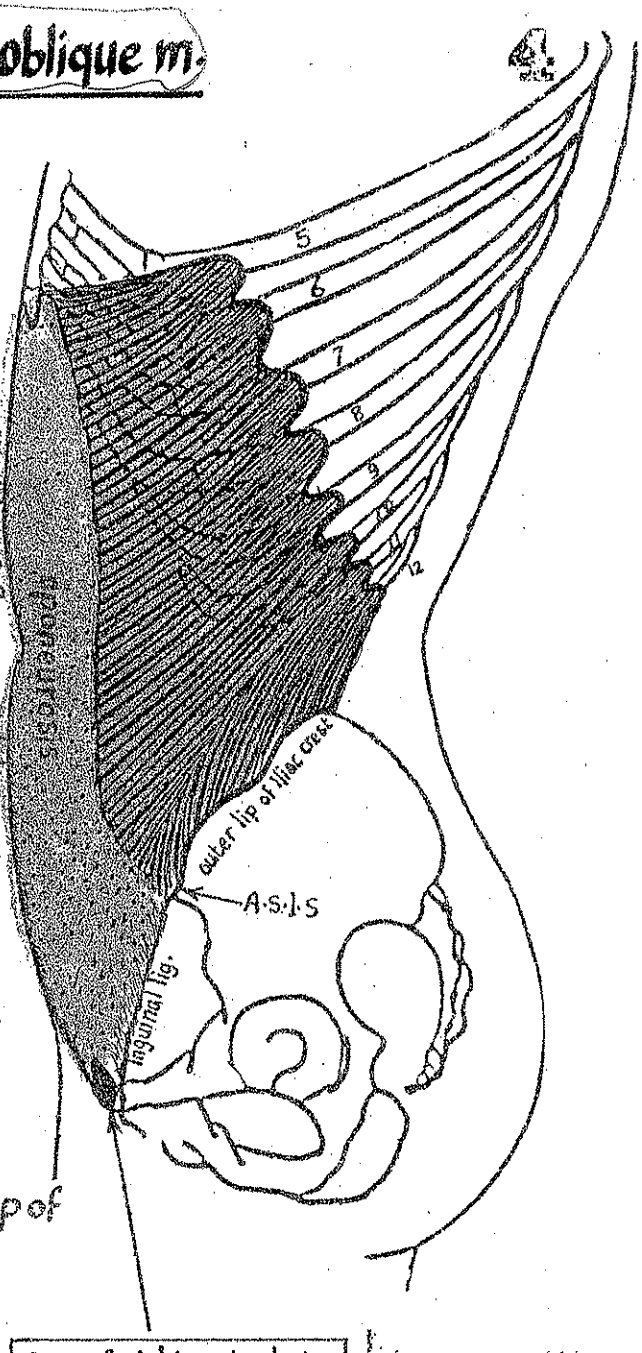
2 Paramedian muscles	3 anterolateral flat muscles
(1) rectus abdominis muscle. (2) pyramidalis muscle.	(1) external abdominal oblique m. (2) internal abdominal oblique m. (3) transversus abdominis m.

A- the 3 flat anterolateral muscles

* General remarks :

	ext. abd. oblique	int. abd. oblique	transversus abd.
			
* General organization	forms the outer layer of the 3 muscles	forms the middle & thickest layer of the 3 muscles	forms the inner & thinnest layer of the 3 muscles
Origin	has one site of origin: Costal : from the ribs.	has 2 sites of origin: (1) lumbar : from lumbar fascia (2) ilioinguinal : from iliac crest & inguinal lig.	has 3 sites of origin: (1) Costal origin. (2) lumbar origin. (3) ilio inguinal origin.
* Direction of fibres	the 3 muscles have 3 different directions (to strengthen the ant. abd. wall).		
	Fibres are directed mainly downwards, forwards & medially	Fibres are directed mainly upwards, forwards & medially	Fibres are directed mainly transversely forwards.
Insertion	the 3 muscles develop 3 broad aponeuroses towards the median plane. These aponeuroses help in formation of a sheath for the rectus abdominis m. then become inserted mainly in the linea alba which is a fibrous band in the ant. middle line extending from the xiphoid process to the symphysis pubis.		

1- External abdominal oblique m.



* **Origin:** (costal):
  from the outer surfaces of the lower 8 ribs by 8 fleshy digitations
  N.B: the upper 4 digitations interdigitate with serratus ant.-m. while the lower 4 " " " lat.-dorsi m.

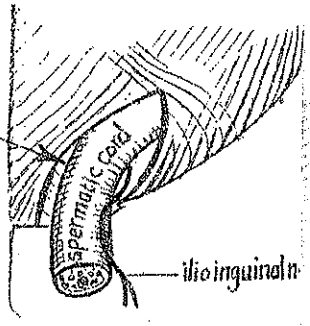
* **Direction of fibres:** most of the fibres run downwards, forwards & medially except:
  (a) the upper most fibres: run horizontally forwards.
  (b) " lower most " : run vertically downwards.

* **Insertion:**
  (1) by an aponeurosis: into xiphoid process, linea alba, pubic crest, pubic tubercle & ant.-sup. iliac spine.
  N.B: the lower border of the aponeurosis extending between the A.S.I.S & pubic tubercle has no bony attachment but is folded backwards & upwards upon itself to form the **Inguinal ligament.**
  (2) by fleshy fibres: into the ant.-½ of the outer lip of iliac crest.

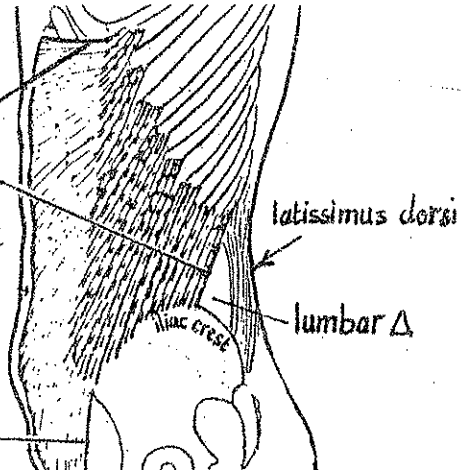
* **N. Supply:** lower 6 thoracic nerves.

* **Particular features:**

(1) Superficial inguinal ring: is a triangular opening in the external oblique aponeurosis lying just above & lat. to pubic crest it is described in detail with the inguinal canal (see page 17)

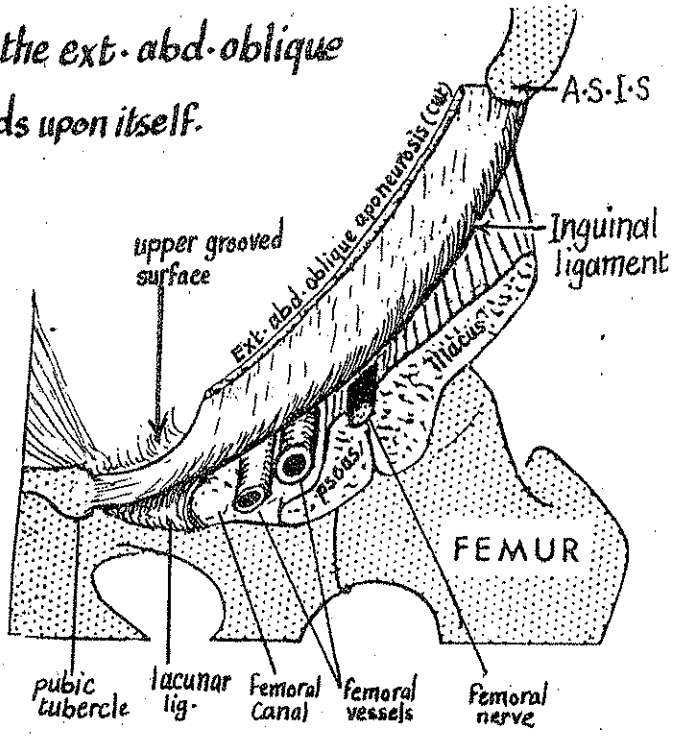


(2) The muscle has 3 free borders:
  (a) an upper horizontal free border
  (b) a posterior vertical free border forming the ant. boundary of the **lumbar triangle** which is bounded posteriorly by latissimus dorsi muscle & inferiorly by the iliac crest.
  (c) lower free border forming the **Inguinal ligament**



The Inguinal (Poupart's) ligament

Definition: it is the thickened lower border of the ext. abd. oblique aponeurosis which is folded backwards & upwards upon itself.



Attachments:
- laterally: to the ant. sup. iliac spine.
- medially: to the pubic tubercle.

Site: it lies below the fold of the groin.

Surfaces:

(1) upper surface (concave & directed upwards):
- its lat. 2/3 gives origin to int. abd. oblique m.
- its lat. 1/3 gives origin to transversus abd. m.
- its grooved med. 1/2 forms the floor of the inguinal canal.

(2) lower surface (convex & directed downwards towards the thigh): it gives attachment to the fascia lata of the thigh.

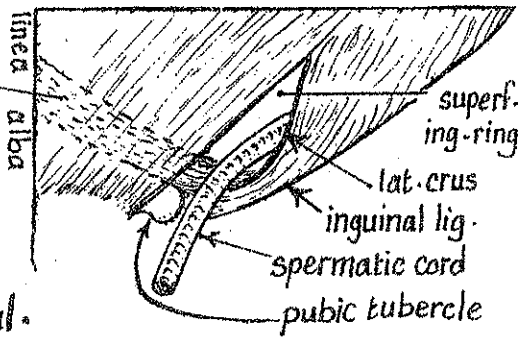
Superficial relations: it is covered by skin & fascia & crossed by superficial epigastric & superficial circumflex iliac vessels.

Deep relations:
(1) femoral sheath (enclosing femoral vessels & femoral canal).
(2) iliacus & psoas major muscles.
(3) femoral n., femoral br. of genitofemoral n. & lat. cutaneous n. of thigh.

Extensions: the med. part of the inguinal lig. gives 2 extensions ↙ lacunar lig. ↘ reflected ".

(A) Lacunar lig.: is a triangular backward extension from the med. end of inguinal lig.
- its apex: is directed medially & attached to the pubic tubercle.
- its base: " " laterally & forms the med. sharp crescenic boundary of femoral ring.
- its ant. border: is continuous with the med. end of the inguinal lig.
- its post. border: is attached to the pectineal line of sup. pubic ramus.

(B) Reflected part of inguinal lig:
- it is an extension from the lat. crus of the superficial inguinal ring.
- it runs upwards & medially behind the spermatic cord to become attached to the linea alba.
- it forms a part of the post. wall of the inguinal canal.

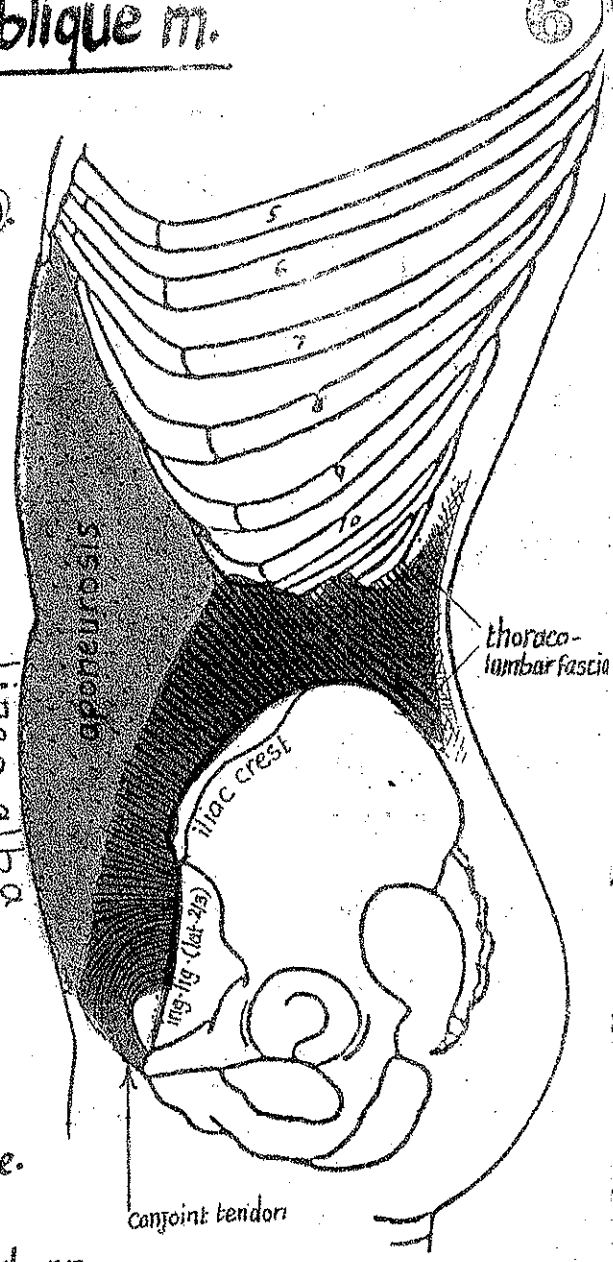


2- Internal abdominal Oblique m.

* **Origin:** 2: lumbar & ilioinguinal:
  (1) From lumbar fascia (deep fascia of the back).
  (2) From ant.-2/3 of intemediate area of iliac crest & from lat.-2/3 of the upper grooved surface of the inguinal ligament.

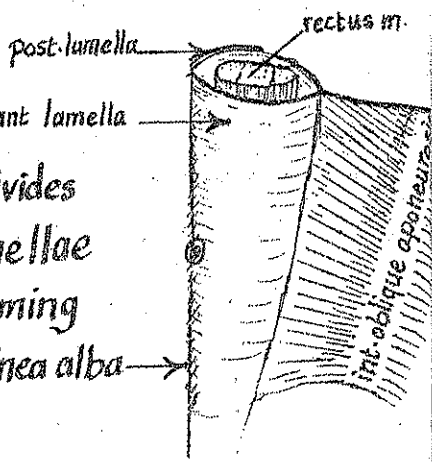
* **Direction of fibres:** most of the fibres pass upwards, forwards and medially- except the lowermost fibres arising from the inguinal ligament which form an arch downwards & medially.

* **Insertion:** Fleshy & aponeurotic:
  (1) the post.-part is inserted by fleshy fibres into the last 3 ribs & costal cartilages
  (2) the remainder of the muscle is inserted by a broad aponeurosis into:
  the 7th, 8th, 9th costal cartilage, xiphoid process, linea alba, pubic crest & pectineal line.

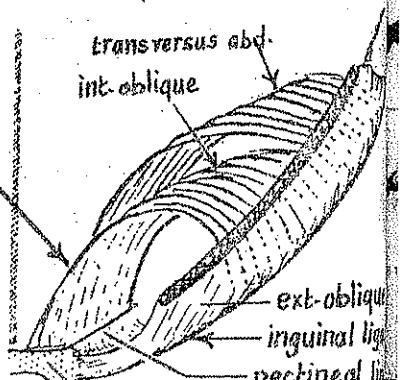


* **N.supply:** the lower 6 thoracic nerves & 1st lumbar n.

* **Particular features:**
  (1) the middle & main part of the internal oblique aponeurosis divides at the lat.-border of the rectus abdominis m. into 2 lamellae (ant.- & post.-). These 2 lamellae enclose the rectus m (forming the main part of the **rectus sheath**) then get attached to the linea alba



  (2) the lowermost aponeurotic fibres (inguinal fibres) of int.-oblique aponeurosis fuses with the lowermost arching fibres of the transversus abd.-m. forming the **Conjoint tendon** which is attached to the pubic crest & the med.-part of the pectineal line of the sup.-pubic ramus.

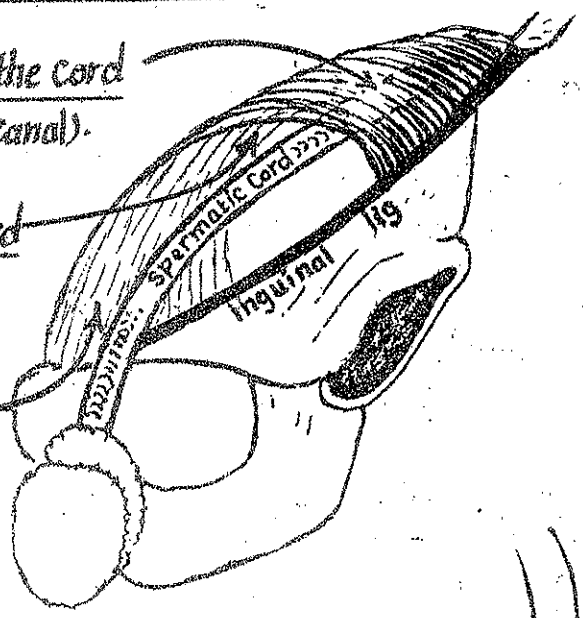


(3) Internal oblique m. has a triple relation to the Spermatic cord:

(a) the fleshy inguinal fibres lie first ant. to the cord (forming lat. part of ant. wall of the inguinal canal).

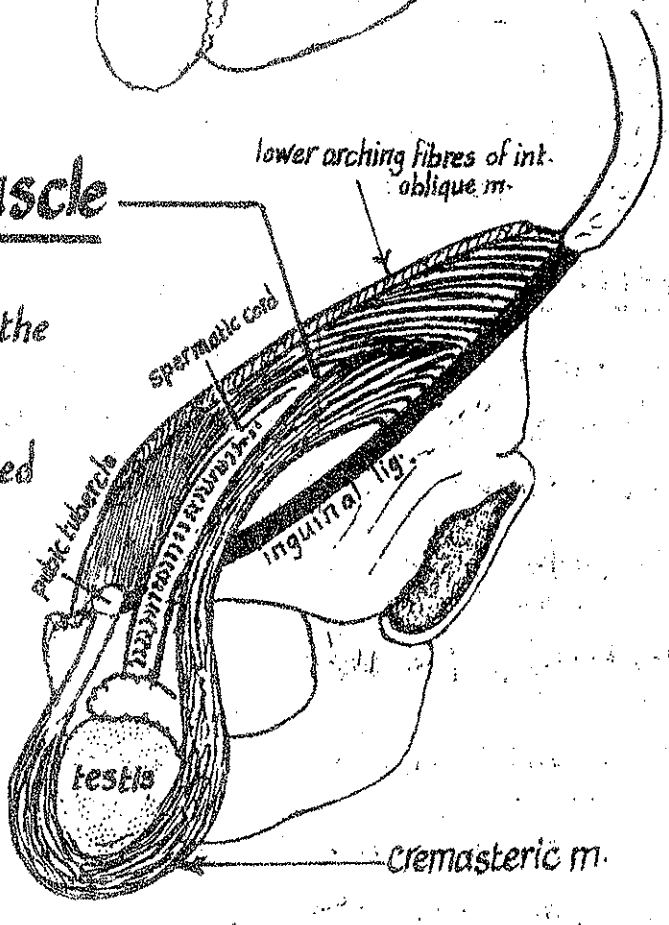
(b) the fleshy fibres then arch above the cord (forming the roof of the inguinal canal).

(c) finally, conjoint tendon lies behind the cord forming the med. part of post. wall of the inguinal canal.



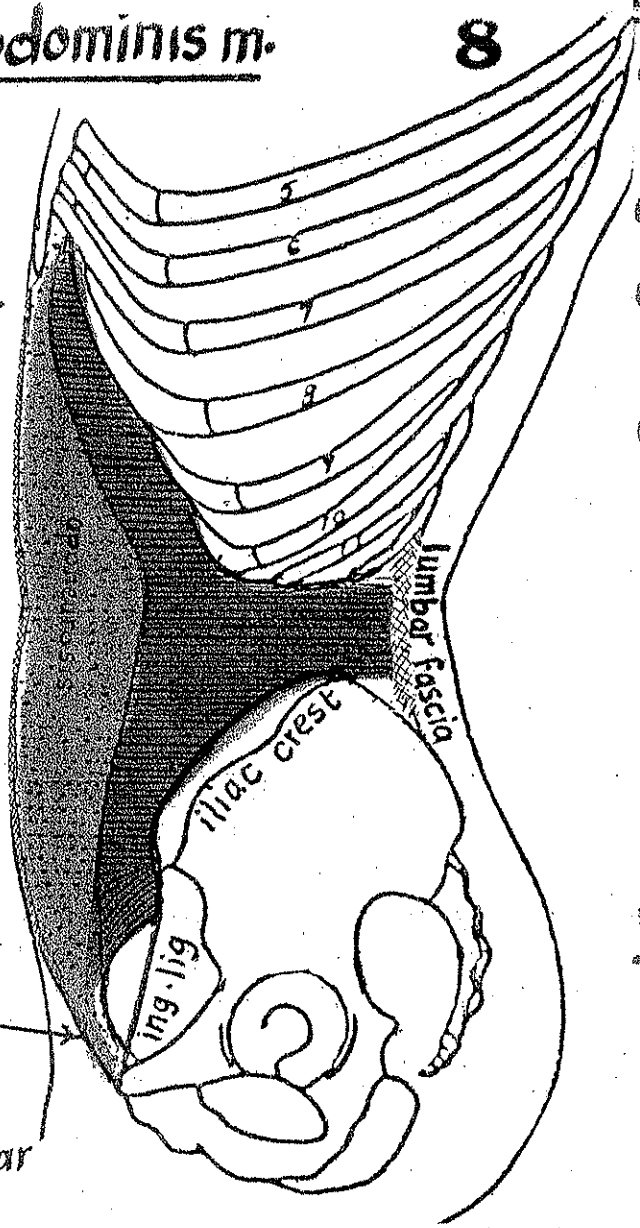
Cremasteric muscle

* it is a slender muscle which suspends the spermatic cord & testis.
* it is covered by loose areolar tissue called the cremasteric fascia.



* **Origin:** from the middle of the inguinal ligament as a detached part from the lower arching fibres of internal oblique m.
* **Insertion:** the fibres form u-shaped loops around the spermatic cord & the testis then collect medially forming a small tendon inserted into pubic tubercle.
* **N. Supply:** genital branch of genitofemoral n. (cremasteric nerve).
* **Action:** it is a striated involuntary muscle which elevates the testis during ejaculation.
* **Cremasteric reflex:** stroking of the med. side of the thigh results in elevation of the testis by reflex contraction of cremasteric m.

3- transversus abdominis m.



* **Origin: 3**: costal, lumbar & ilioinguinal:
  (1) costal: from inner surfaces of the lower 6 ribs (interdigitating with the origin of diaphragm).
  (2) lumbar: from lumbar fascia.
  (3) ilioinguinal: from ant 2/3 of inner lip of iliac crest & from lat. 1/3 of inner grooved surface of inguinal lig.

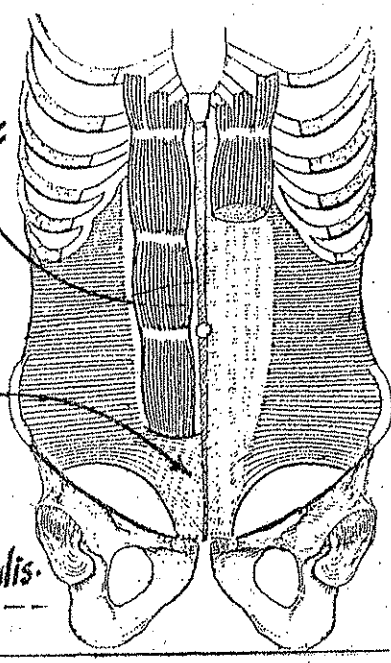
* **Direction of fibres:** most of the fibres pass horizontally forwards except the lowermost (inguinal) fibres which run downwards & medially to join the conjoint tendon.

* **Insertion:** by a broad aponeurosis into xiphoid process, linea alba. The lowermost part of the aponeurosis joins the conjoint tendon (inserted into pubic crest & pectineal line).

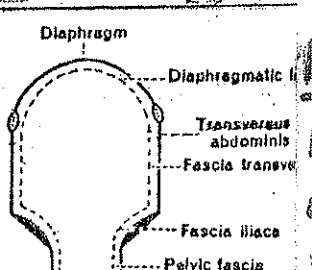
* **N. Supply:** lower 6 thoracic nerves & 1st lumbar

* **Particular features:**

  (1) the transversus aponeurosis has a double relation to rectus m.:
    (a) the upper 3/4 of the aponeurosis passes behind the rectus m. sharing in the formation of the post. wall of the rectus sheath.
    (b) the lower 1/4 of the aponeurosis passes infront of rectus m. & shares in the formation of the lower part of the ant. wall of the rectus sheath.
  (2) the transversus m. is lined internally by fascia transversalis.



Fascia transversalis



* **Definition:** it is that part of the abdomino-pelvic fascia which lines the inner surface of transversus abd. m. It is separated from the parietal peritoneum by extra-peritoneal fatty tissue.

Extensions :

(1) anteriorly : it is continuous with its fellow of the opposite side being adherent to linea alba above the umbilicus.

(2) posteriorly : it is continuous with the renal fascia.

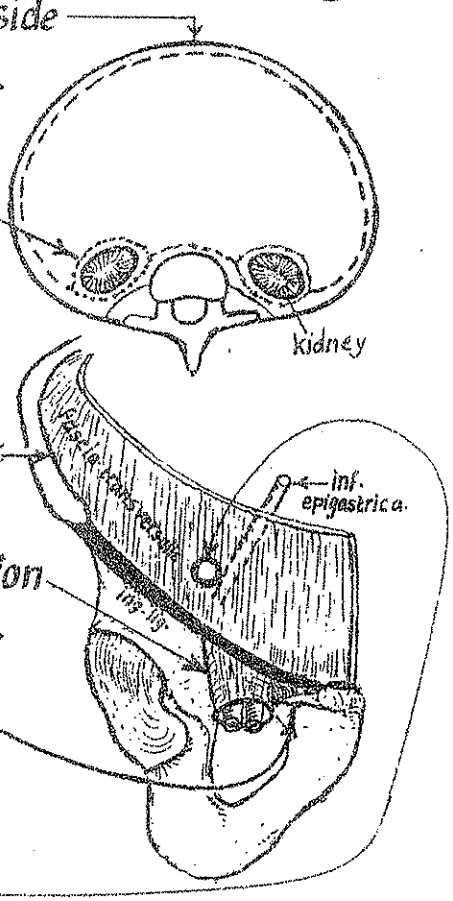
(3) Superiorly : it is continuous with the diaphragmatic fascia lining the lower surface of the diaphragm.

(4.) Inferiorly : it has the following attachments :

(a) lat. to ext. iliac vessels : it is attached to inner lip of iliac crest & lat. ½ of ing. lig. (being continuous with fascia iliaca at these sites).

(b) over the ext. iliac vessels : it sends a downward prolongation into the thigh (forming the ant. wall of the femoral sheath).

(c) med. to the ext. iliac vessels : it is attached to pectineal line & Pubic crest (blending with the pelvic fascia).



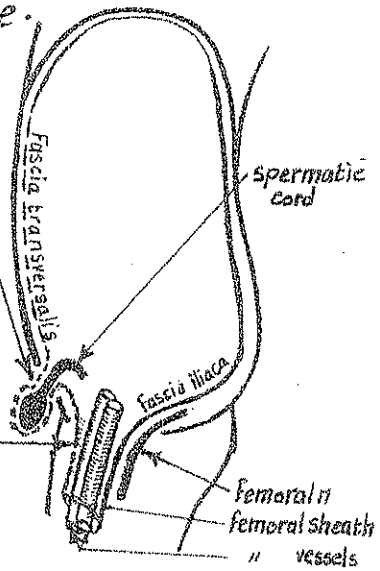
Opening : the deep inguinal ring :

- Shape : it is an oval opening (gap) in the fascia transversalis.
- Site : it lies ½ an inch above the midinguinal point.
- relations : it lies just lat. to the inf. epigastric a. & below the arching fibres of transversus abd. m.
- it transmits : - the constituents of the spermatic cord in the male
  - the round lig. of the uterus in the female.

Prolongations of fascia transversalis :

(1) Internal Spermatic fascia : it is a prolongation of fascia transversalis from the margins of the deep inguinal ring around Spermatic cord & testis.

(2) ant. wall of the femoral sheath : it is a downward prolongation of fascia transversalis over the femoral vessels into the thigh.



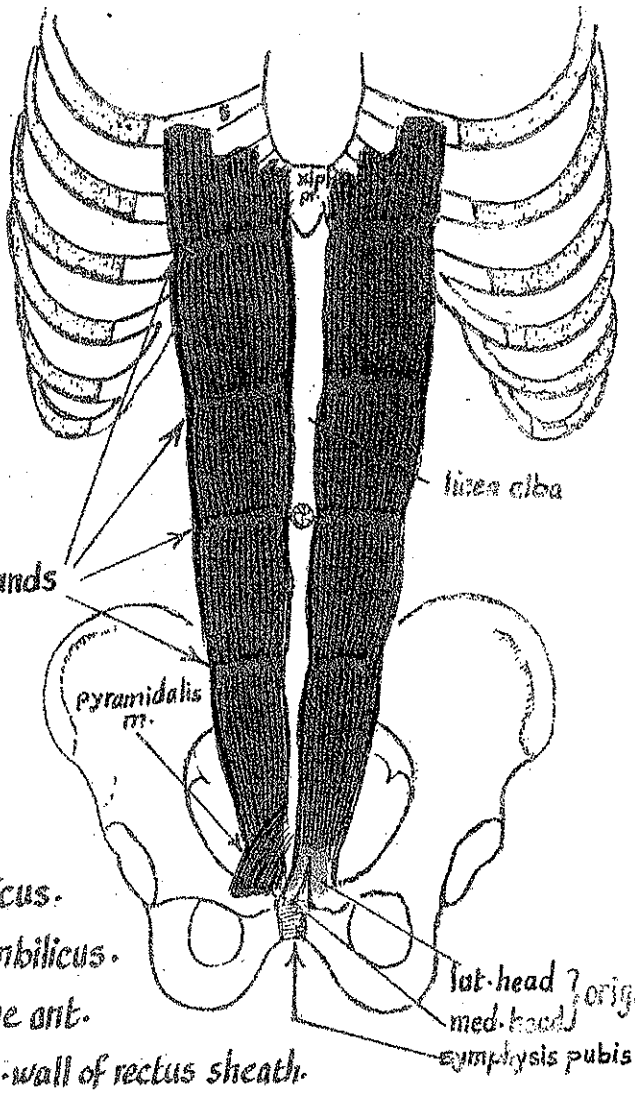
Relation of fascia transversalis to vessels & nerves : the main arteries of the abdominal wall & pelvis lie inside fascia transversalis while the main nerves lie outside it. That is why femoral vessels lie inside the femoral sheath (which is a downward prolongation of the fascia) while the femoral n. lies outside the sheath.

Rectus abdomins m. 10

* It is a longitudinal paramedian muscle (one on each side of linea alba).

* **Origin**: the lower end of the muscle (1" wide). It arises by 2 tendinous heads:
  (1) med. head: from the front of symphysis pubis.
  (2) lat. head: from the pubic crest.

* **Insertion**: the upper end (3" wide):
  inserted by fleshy fibres into the front of the 5th, 6th, 7th costal cartilages & xiphoid process (along a horizontal line).

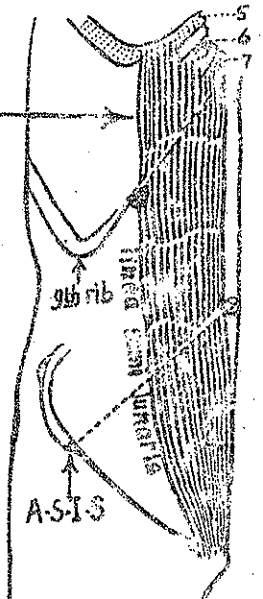


* **N. supply**: lower 6 thoracic nerves.

* **particular features**:

(1) **tendinous intersections**: 3-4 transverse bands dividing the muscle into segments.
- they are located at the following levels:
  (a) one at the level of the xiphoid process.
  (b) one " " " " " umbilicus.
  (c) one midway between xiphoid process & umbilicus.
  (d) a 4th one may be present somewhere below umbilicus.
- the tendinous intersections are seen only on the ant. surface of the muscle & are adherent to the ant. wall of rectus sheath.
- they indicate the segmental origin of the muscle (formed by fusion of number of myotomes).

(2) **Linea Semilunaris**:
- it is a shallow curved groove along the lat. border of the muscle.
- its surface anatomy is represented by a line convex outwards connecting the following 4 points:
  (a) pubic tubercle.
  (b) point midway between the Ant. sup. iliac spine & the umbilicus.
  (c) point on the costal margin at the tip of the 9th rib.
  (d) a point at the 5th costochondral junction.



(3) Each rectus muscle is enclosed in a fibrous sheath

The Rectus Sheath

* **Definition:** it is an aponeurotic sheath enveloping the rectus & pyramidalis muscles with their associated nerves and vessels.

* **Formation:** the main event leading to the formation of the rectus sheath is the splitting of the int. oblique aponeurosis, at the lat. border of the rectus m., into 2 lamellae (ant. & post.) which envelop the rectus m. then re unite at the linea alba.
  - the **ant. lamella** passes infront of the rectus & is reinforced by the ext. oblique aponeurosis forming the major part of the ant. wall of rectus sheath.
  - the **post. lamella:** passes behind the rectus & is reinforced by the transversus aponeurosis forming the major part of the post. wall of the sheath.

  N.B: in the lower part of the ant. abdominal wall, the int. oblique aponeurosis passes undivided, together with the transversus aponeurosis, to lie infront of rectus m.

* **Parts of the rectus sheath:** the rectus sheath can be divided into 3 parts:

(1) First part: above the level of the costal margin.
(2) second " : extending from costal margin to a line ½ way between umbilicus to symph. pubis.
(3) third " : extending from the previous line above to the symphysis pubis below.

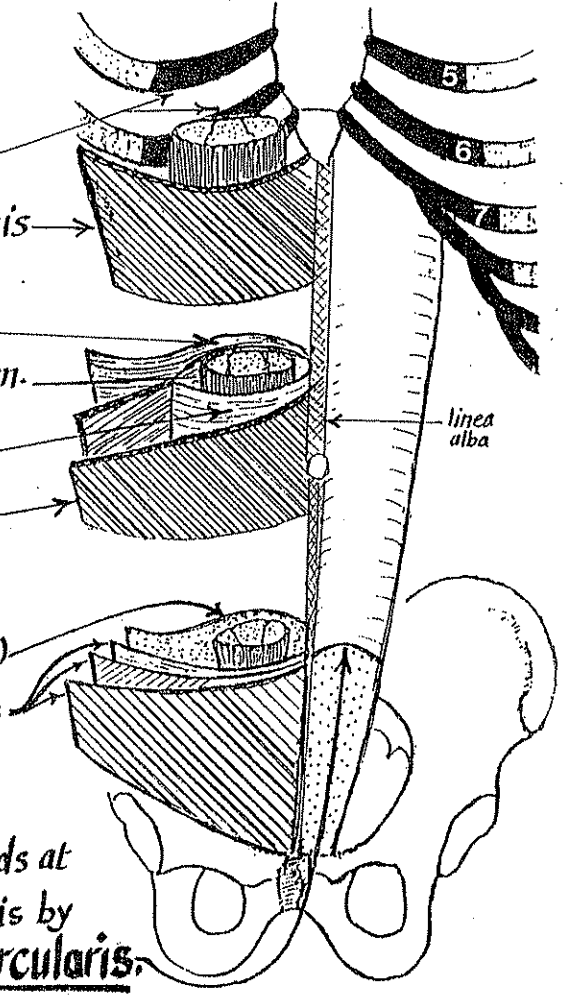
* **Structure of each part of the sheath:**

(1) **1st part:**
- post. wall: is formed by costal cartilages only.
- ant. wall: is formed by the ext. oblique aponeurosis

(2) **2nd Part:**
- post. wall formed by (1) transversus aponeurosis, (2) post. lamella of int. oblique m.
- ant. wall " " (1) ant. lamella of int. oblique, (2) ext. oblique aponeurosis

(3) **3rd Part:**
- post. wall: is deficient (formed by fascia tranversalis)
- ant. wall: formed by the aponeuroses of the 3 muscles (ext. oblique, int. oblique & transversus abd. which all pass infront of the rectus muscle).

N.B: the aponeurotic post. wall of the rectus sheath ends at the line ½ way between umbilicus & symphysis pubis by forming an arched border called **linea Semicircularis** or **arcuate line**.



* Significance (functions) of the rectus sheath:

(1) it checks bowing of the rectus m. during its contraction thus increases its efficiency.

(2) it maintains the strength of the ant-abdominal wall.

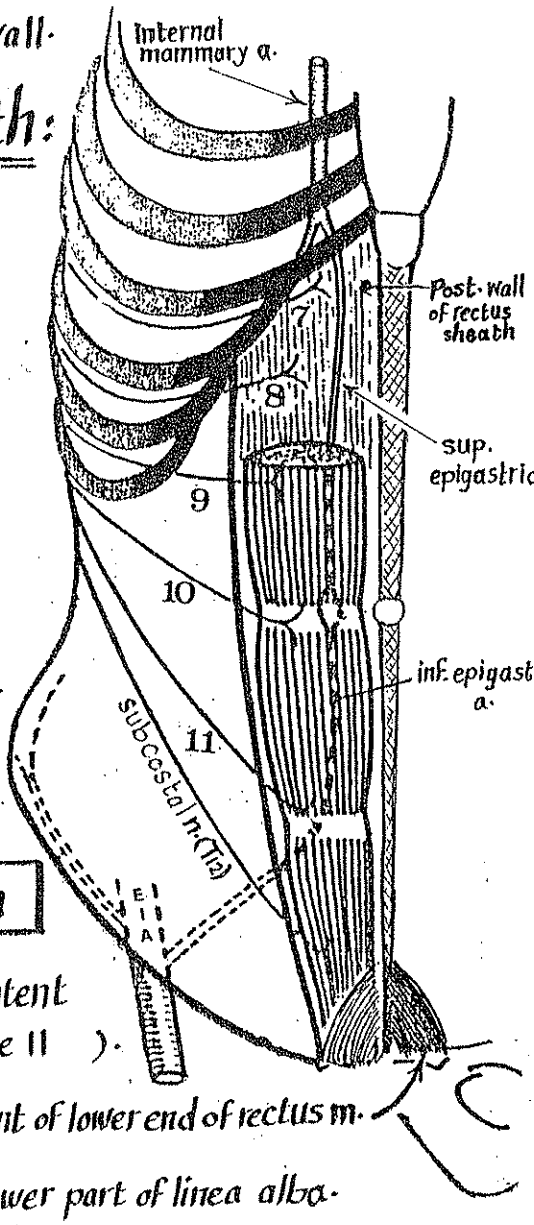
* Contents of the rectus sheath:

(A) 2 muscles — rectus abdominis muscle.
— pyramidalis muscle.

(B) 4 vessels — (1) sup. epigastric a.
(2) sup. epigastric v.
(3) inf. epigastric a.
(4) inf. epigastric v.

(C) 6 nerves: terminal parts of the lower 5 intercostal nerves + subcostal n.

(D) lymphatic Vessels.



* Comment on the Contents of the Sheath

(1) **Rectus abdominis m.**: the chief & largest content of the sheath (see page 11).

(2) **Pyramidalis m.**: a small triangular m. infront of lower end of rectus m.

- Origin: from the pubic crest — Insertion: lower part of linea alba.
- N. supply: subcostal n. — Action: stretches linea alba.

N.B: pyramidalis m. may be present or absent.

(3) **Sup. epigastric artery:**

- Origin: arises as one of the 2 terminal branches of internal mammary opposite the 6th intercostal space.
- Course:
  - it passes downwards behind the 7th costal cartilage to enter the upper part of rectus sheat
  - It descends between the rectus m. & the post. wall of the rectus sheath.
- termination: it ends at the level of the umbilicus by anastomosing with inf. epigastric a.
- Branches: (1) muscular branches: supplying the upper part of rectus abd. m.
  (2) cutaneous " : " the skin overlying upper part of rectus.

(4) Sup. epigastric vein:
accompanies its artery & drains into the internal mammary v. (belongs to the S.V.C)

(5) Inf. epigastric a.: (larger than the sup. epigastric a.):

- Origin: it arises from the external iliac a. just above the inguinal ligament.
- Course:
  - it runs upwards & medially medial to the deep inguinal ring.
  - it pierces the fascia transversalis to enter the rectus sheath infront of the arcuate line.
  - it ascends between the rectus m. & the post. wall of the rectus sheath.
- termination: at the level of the umbilicus by anstomosing with sup. epigastric a. (forming a link between subclavian a. above & ext. iliac a. below).
- Branches:
  - (a) pubic branch: descends behind lacunar lig. & pubic bone to anastomose with the pubic branch of obturator a.
  - (b) Cremasteric br.: enters the deep inguinal ring & passes among the contents of the spermatic cord to supply cremasteric m. & ends by anastomosing with the testicular artery.
  - (c), (d), (e): muscular, aponeurotic & cutaneous branches supplying the rectus m., its sheath & the overlying skin.

(6) Inferior epigastric vein: accompanies its artery & drains into the ext. iliac V. (belongs to the I.V.C.). It anastomoses with the sup. epigastric v. This anastomosis is a link between the S.V.C & the I.V.C.

(7) the lower 5 intercostal & the Subcostal n.

- at first they run medially between the internal oblique & transversus abd. muscles.
- then they enter the rectus sheath by piercing its post. wall
- they pierce the rectus m. (supplying it) then pierce the ant. wall of the rectus sheath to end as ant. cutaneous nerves.

The Linea Alba

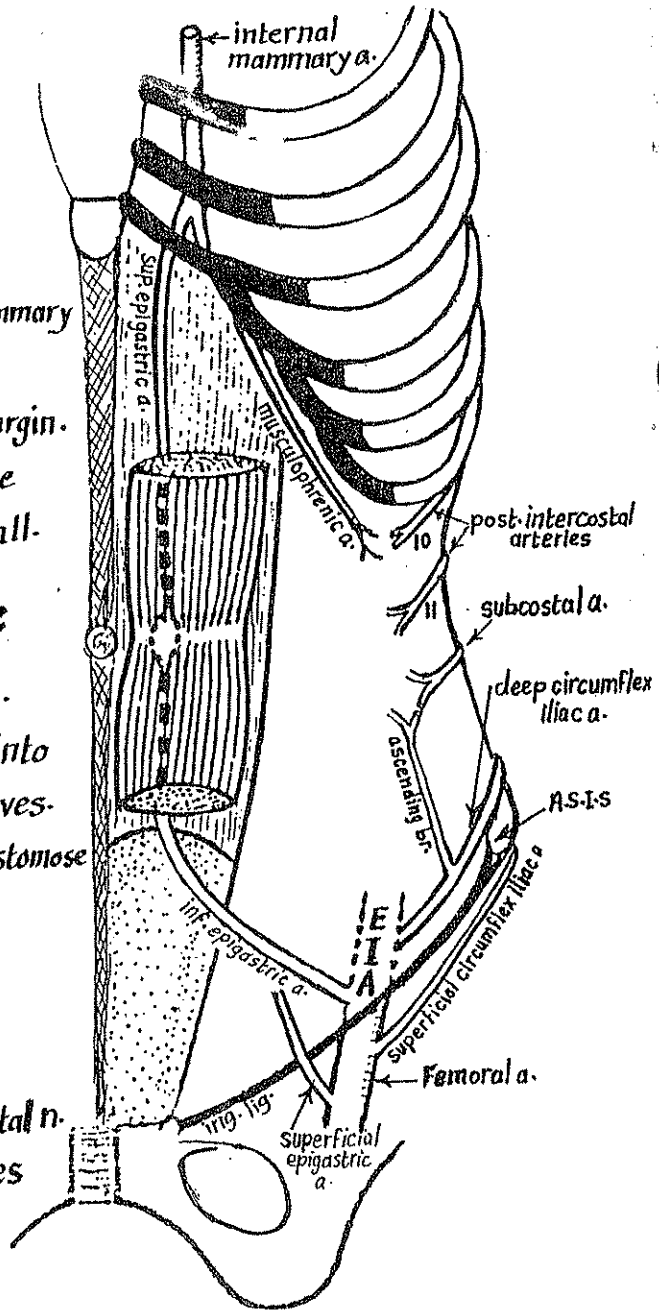
* Definition: it is a strong tendinous raphé in the middle line of the ant. abd. wall (between the 2 recti). It is formed by the interlacing fibres of the aponeuroses of the oblique & transversus muscles of both sides
* Attachments: Above: attached to xiphoid process, below: attached to symphysis pubis.
* Characters: (1) it shows the umbilical scar in its middle (2) below the umbilicus it is narrow. (3) above the umbilicus it is wide ($1\frac{1}{2}$ cm) (4) it is a bloodless line.

Arterial Supply of anterolateral abd. wall

* The anterolateral abdominal wall is supplied by the following arteries:

(1) Sup. epigastric a.
(2) Inf. epigastric a. } run in the rectus sheath (see page 12&13)
(3) musculo-phrenic a.

- Origin: one of the 2 terminal branches of internal mammary artery at the level of 6th intercostal space.
- Course: it runs downwards & laterally along the costal margin.
- Branches: it supplies the lower intercostal spaces, the diaphragm & the upper part of ant. abd. wall.



(4) the 10th, 11th post. intercostal arteries:

- they are branches of the descending thoracic aorta.
- they continue anteriorly from the intercostal spaces into the ant. abdominal wall accompanying intercostal nerves.
- they supply the transversus & oblique muscles & anastomose with the musculophrenic & subcostal arteries.

(5) Subcostal artery:

- arises from the descending thoracic aorta.
- runs below the last rib accompanied by subcostal n.
- it passes first deep to transversus m. then pierces it & runs between it & internal oblique m.

(6) Deep circumflex iliac artery:

- Origin: arises from the external iliac a. just above the inguinal ligament.
- Course: it pierces the fascia transversalis, passes upwards & laterally along the inguinal lig. towards the A.S.I.S then runs along the inner lip of iliac crest as far as its middle.
- Branches: (1) muscular: to the muscles of the lower part of the ant. abdominal wall.
  (2) ascending br.: arises opposite the A.S.I.S & runs upwards between the transversus abd. & int. oblique muscle (supplying both muscles). (3) anastomotic branches sharing in the anastomosis around A.S.I.S (with superficial circumflex iliac a. & lat. circumflex femoral a.).

(7) Superficial epigastric a.
(8) Superficial circumflex iliac a.: } are 2 branches of the femoral a. which ascend superficial to the inguinal lig. to supply the lower part of the ant. abdominal wall.

Venous drainage of the anterolateral abd. Wall

(A) **Above the level of the umbilicus** the abdominal wall:
is drained by the following veins on each side:

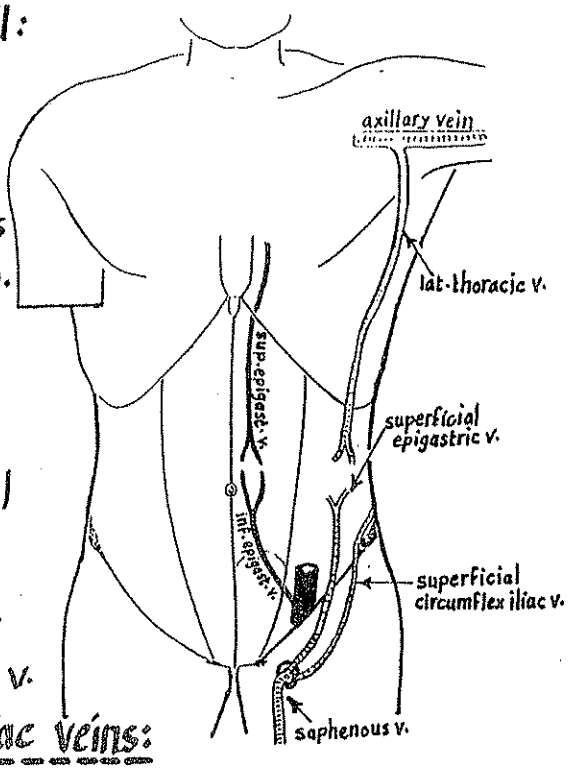
(1) **Superior epigastric v.**: runs deep to the rectus m. in the rectus sheath close to the middle line. It ends in the internal mammary v. (tributary of innominate v.).

(2) **lat. thoracic v.**: ascends in the superficial fascia on the side of the chest to end in the axillary v.

(B) **Below the level of the umbilicus**: the abdominal wall is drained by the following veins:

(1) **Inf. epigastric v.**: runs deep to the rectus m. in the rectus sheath to end in the ext. iliac v.

(2) **superficial epigastric & superficial circumflex iliac veins:**
are the superficial veins of the groin which run in the superficial fascia to end in the great saphenous v. (a tributary of the femoral v.).



Venous anastomoses of ant. abd. wall

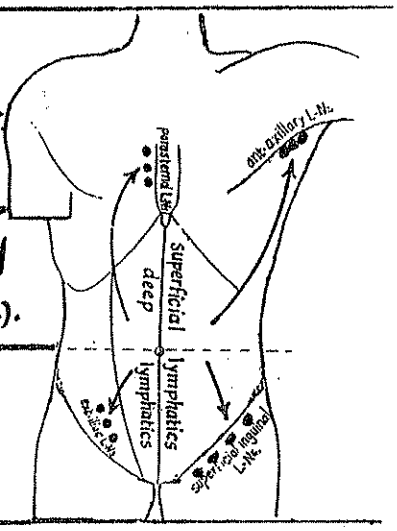
(1) the anastomosis between the sup. epigastric v. & the inf. epigastric v. in the rectus sheath. It is a link between the S.V.C & the I.V.C.

(2) the anastomosis between the lat. thoracic v. & the superficial epigastric v. through the thoracoepigastric v. which lies in the superficial fascia of the side of the trunk. This is also a link between the S.V.C & the I.V.C.

(3) Around the umbilicus there is an anastomosis between the veins of the ant. abd. wall (systemic veins belonging to the S.V.C & I.V.C) and the paraumbilical veins which drain into the portal v. of the liver. This is a portosystemic anastomosis.

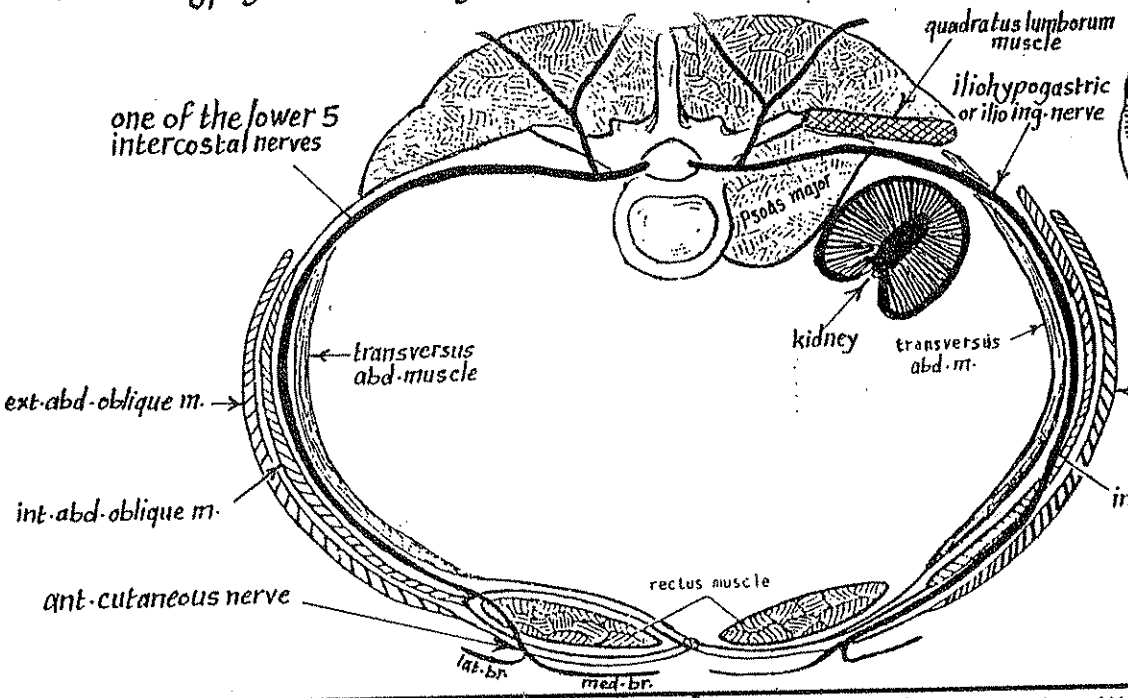
Lymphatic drainage of ant. abd. wall

	Superficial lymphatics (follow veins)	deep Lymphatics (follow arteries)
Above umbilicus	drain into the ant. (pectoral) group of axillary lymph nodes.	drain into the parasternal L.Ns (along int. thoracic a.).
below umbilicus	drain into the superficial inguinal lymph nodes	drain into the ext. iliac lymph nodes along the ext. iliac vessels.



Nerve Supply of anterolateral abdominal Wall

* the anterolateral abdominal wall is supplied by branches from:
  (A) the lower 5 intercostal nerves (T_7-T_{11}) & subcostal n. (T_{12}).
  (B) the iliohypogastric & ilioinguinal nerves (L_1).



Course of the lower 5 intercostal & subcostal n.

(1) they leave the costal grooves & enter the ant. abd. wall by passing between the digitations of diaphragm & transversus abdominis m.

(2) they run anteromedially between the int. oblique & transversus abd. muscles.

(3) at the lat. border of rectus abd. m., they pierce the post. wall of the rectus sheath then the rectus m. & finally the ant. wall of rectus sheath to end by becoming the anterior cutaneous n.

N.B: the nerves acquire the following directions:
(a) T_7 & T_8 incline upwards
(b) T_9 passes horizontally forwards.
(c) T_{10} & T_{11} & the subcostal n. (T_{12}) incline downwards.

Course of iliohypogastric & ilioinguinal nerve

(1) they emerge from the upper part of lat. border of psoas major m. & run obliquely downward & laterally between the kidney infront & the quadratus lumborum muscle behind.

(2) above the iliac crest, both nerves pierce the transversus abd. m. & run between it & the internal oblique in a forward direction.

(3) at the level of the ant. sup. iliac spine, both nerves pierce the int. oblique & run medially between it & the ext. oblique as sensory nerves

(4) then each n. reaches the skin as follows:
(a) the iliohypogastric n. pierces the ext. oblique 1" above the superficial inguinal ring to supply the skin above the symphysis pubis
(b) the ilioinguinal n. emerges from the superficial inguinal ring to supply the skin of the external genitalia.

Branches of the lower 5 intercostal & subcostal n.	Branches of the iliohypogastric & ilioinguinal nn.
(A) **muscular branches**: to the ext. oblique, int. oblique, transversus abd. & rectus abd. m. (the pyramidalis m. is supplied by the subcostal n. only).	(A) **muscular branches**: to supply the internal oblique & transversus abd. muscles
(B) **Cutaneous branches**:	(B) **Cutaneous branches**:
(1) lat. cutaneous br.: emerges between the digitations of ext. oblique m. to supply the skin of the lat. part of the abd. wall.	(1) the iliohypogastric n. has 2 cut. branches: (a) lat. cut. br. to the skin of the ant. part of the buttock. (b) ant. cut. br. to the skin above the pubis.
(2) ant. cutaneous br.: pierces the ant. wall of the rectus sheath close to the median plane to supply the skin of the ant. part of the abdominal wall.	(2) the ilioinguinal n.: has no lat. cut. br. but gives only ant. cut. n. (which is the continuation of the n.) to supply the skin of ext. genital organs & upper part of med. side of the thigh.
(C) **Sensory branches**: to the parietal peritoneum.	

Action of the abdominal muscles

(1) **Supportive action**: the normal tone of the abd. muscles provides a firm but elastic support for abd. viscera against gravity.

(2) **Protective action**: by reflex contraction, the abd. muscles help to protect the intra-abdominal viscera against external violence.

(3) **Expulsive action**: the muscles of the ant. abd. wall contract simultaneously with the diaphragm to compress the abdominal viscera thus helping in all expulsive acts e.g. micturition, defecation, parturition & vomiting.

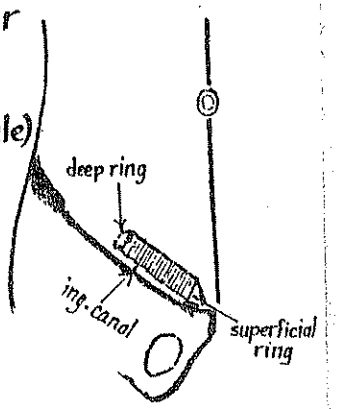
(4) **Expiratory action**: the ext. abd. oblique m. can depress the ribs thus compressing the lower part of the thorax producing forced expiratory acts as in coughing, sneezing & blowing.

(5) **Movement of the trunk**:

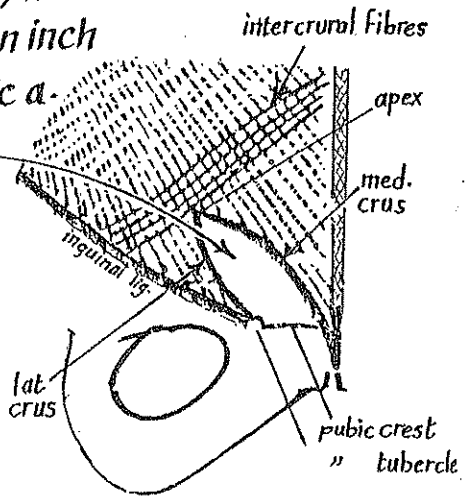
(a) forward flexion of the trunk: by the contraction of the rectus abd. m.
(b) lat. flexion of the trunk: by one sided contraction of the oblique muscles.
(c) rotation of the trunk: by a combined action of ext. oblique with the opposite internal oblique.

(6) **Cremaster m.**: helps to suspend the testis.

INGUINAL CANAL



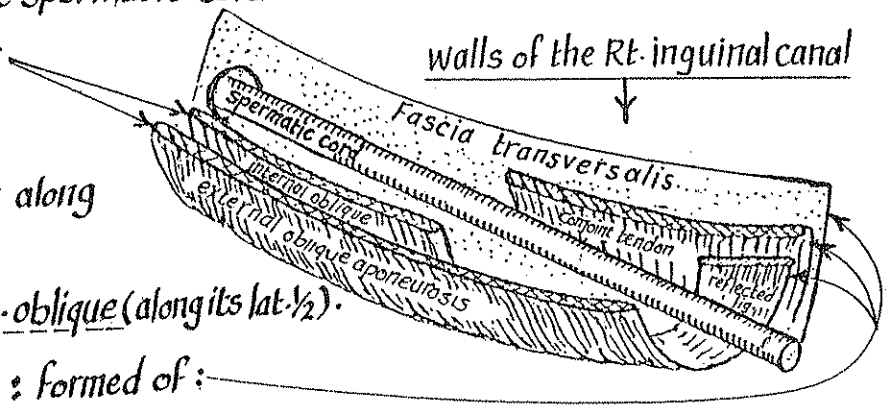
* **Definition:** it is an oblique intermuscular passage in the lower part of the ant. abdominal wall transmitting the spermatic cord (in the male) or round lig. of uterus (in the female)
* **Site:** it is situated just above the med. ½ of the inguinal lig.
* **Length:** 1½ inch (4 cm.).
* **Direction:** it is directed downwards, forwards & medially.
* **Beginning:** it begins at the **deep inguinal ring** (page 8) which is an oval opening in the fascial transversalis lying ½ an inch above the midinguinal point just lat. to the inf. epigastric a.
* **End:** it ends at the **superficial inguinal ring:**



- shape: it is a triangular slit (one inch long).
- site: in the ext. oblique aponeurosis just above & med. to the pubic tubercle.
- base: formed by the lat. ½ of the pubic crest.
- apex: directed upwards & laterally.
- sides: are called the crura:
  the med. crus is attached below to the symphysis pubis.
  the lat. crus " " " " " pubic tubercle.

- the intercrural fibres: are diagonal fibres that prevent the separation of the 2 crura. They represent fibres that cross the middle line from one ext. abd. oblique to the other.
- A prolongation called external spermatic fascia extends from the margins of the ring to surround the spermatic cord

* **Ant. wall of the Canal:**

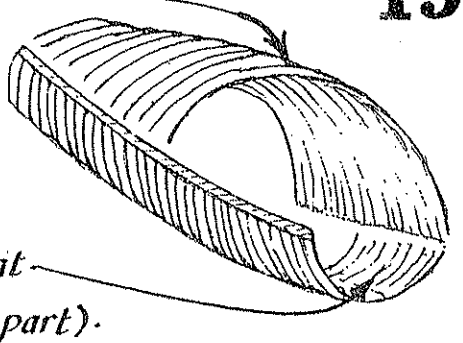


formed of:
(1) external oblique aponeurosis along its whole length.
(2) fleshy fibres of origin of int. oblique (along its lat. ½).

* **Post. wall of the Canal:** formed of:
(1) fascia transversalis: along its whole length.
(2) conjoint tendon: along its med. ½.
(3) reflected part of inguinal lig.: along its med. ¼.

* **Roof of the canal:**

formed by the lower arched fibres of the internal oblique muscle.



* **Floor of the canal:** formed by:

(1) the grooved upper surface of the inguinal ligament.
(2) the upper surface of the lacunar lig. (in the med. part).

* N.B: (1) the ant. wall of the canal is strengthened laterally (opposite the deep ring).
(2) the post. wall of the canal is strengthened medially (opposite the superficial ").

* **Sex differences:** the inguinal canal is wider in males than in females.

* **Structures passing through the canal:**

(a) in the male: the spermatic cord & its coverings + the ilio inguinal n.
(b) in the female: the round lig. of the uterus + the ilio inguinal n.
N.B: the ilio inguinal n. pierces the post. wall of the canal then passes out through the superficial inguinal ring.

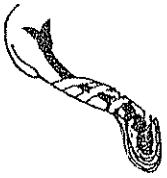
* **Mechanism of the inguinal canal:**

the presence of the inguinal canal represents a weakness in the lower part of the ant. abd. wall. This weakness is compensated by the following mechanisms:

(1) the shutter mechanism of the internal oblique m.
on straining, the lower arched fibres of the int. oblique contract approximating the roof to the floor like a shutter.

(2) the flap valve mechanism:
the 2 inguinal rings do not lie opposite each other (due to the obliquity of the canal). Therefore, when the intra abdominal pressure rises the ant. & post. walls of the canal are approximated thus obliterating the passage.

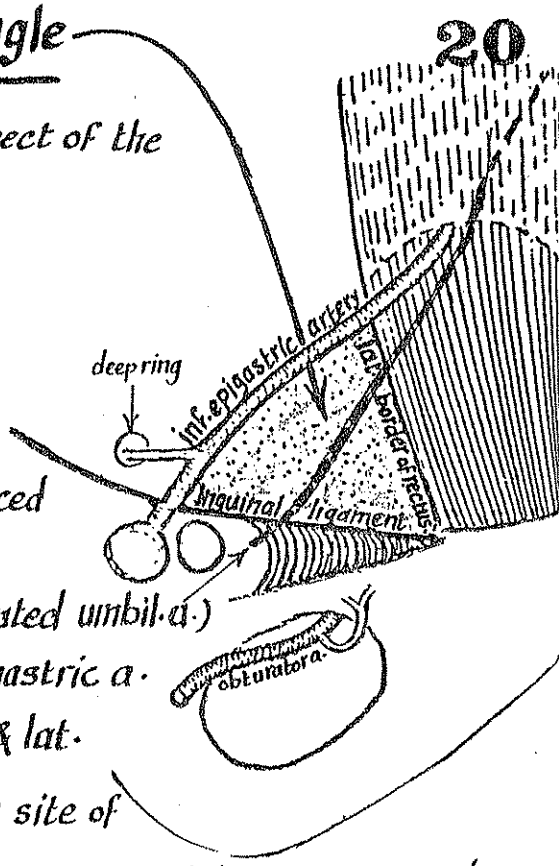
(3) the ball valve mechanism:
contraction of the cremasteric muscle helps the spermatic cord to plug the superficial inguinal ring.



(4) the slit valve mechanism:
contraction of the ext. oblique m. approximates the 2 crura of the superficial ring thus narrowing it to a slit. The intercrural fibres prevent the separation of the 2 crura.
(5) the superficial ring is guarded from behind by the conjoint tendon & the reflected lig.
(6) the deep ring is guarded anteriorly by the fleshy fibres of the int. oblique m.

all these mechanisms help to narrow the canal & its openings during increased intra-abd. pressure thus prevent the herniation of the abdominal viscera.

Inguinal (Hasselbach's) triangle



* **Definition**: it is a triangular area on the inner aspect of the lower part of ant. abdominal wall.

* **Boundaries**:
  (1) medially: the lat. border of rectus abdominis m.
  (2) laterally: the inf. epigastric artery.
  (3) inferiorly: the med. ½ of the inguinal ligament.

* **Floor**: formed by fascia transversalis & is reinforced medially by the conjoint tendon.

* **subdivisions**: the med. umbilical fold (obliterated umbil. a.) crosses the inguinal Δ med. to the inf. epigastric a. dividing the triangle into 2 parts: med. & lat.

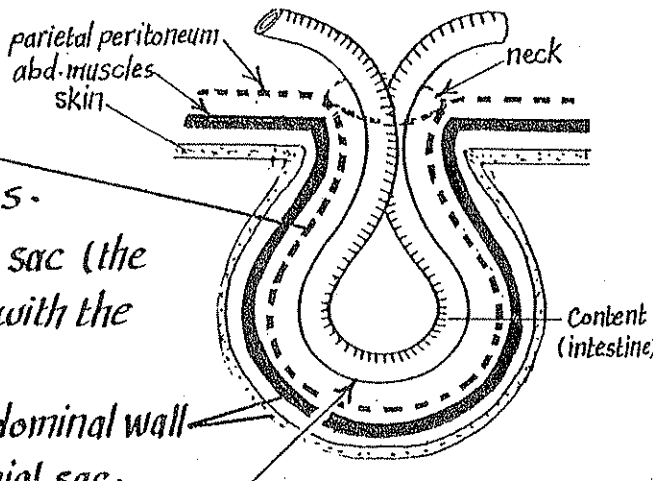
* **Clinical importance**: the inguinal Δ may be a site of a hernia called the direct inguinal hernia due to weakness of the conjoint tendon.

Hernia

* **Definition**: it is an abnormal protrusion of any abdominal viscus (commonly a loop of the small intestine or a part of the greater omentum) through a weak part of the abdominal wall.

* **Cause**: for the hernia to occur, 2 conditions should exist:
  (1) presence of a defect in the abd. wall (weak part or unobliterated fœtal duct).
  (2) increased intra-abdominal pressure: as in chronic cough, chronic constipation or lifting a heavy object.

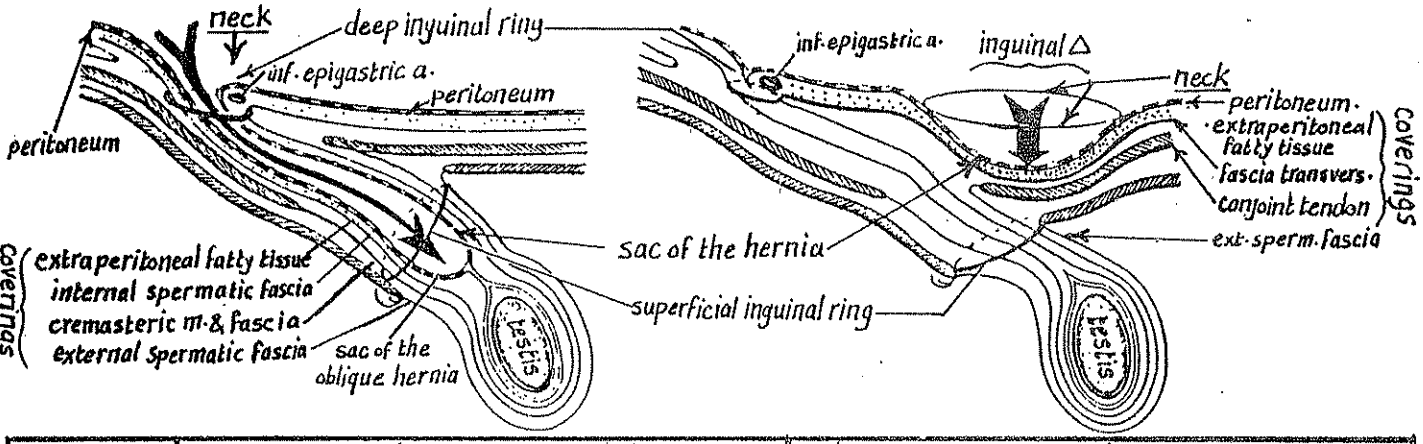
* **Structure of the hernia**:



  (1) **sac** of parietal peritoneum which is pushed by the protruding viscus.
  (2) **neck**: the narrow proximal part of the sac (the site where the sac communicates with the peritoneal cavity).
  (3) **Coverings**: are the structures of the abdominal wall which are pushed by the hernial sac.
  (4) **Contents**: the protruded abd. viscus inside the sac

INGUINAL HERNIA

there are 2 types of hernia occuring in the inguinal region → oblique (indirect), direct



	Oblique (indirect) inguinal hernia	direct inguinal hernia
Cause	persistence of processus vaginalis + increased intra abdominal pressure.	weakness of the ant. abd. wall (mainly the conjoint tendon) + increasead intra-abdominal pressure.
Incidence	- Commoner in young age. - usually unilateral.	- Commoner in old age } due to diffuse - usually bilateral } fibrosis of the ant abd. wall in old age
Neck	lies at the deep inguinal ring just lat. to the inf. epigastric a.	lies at the inguinal triangle (med. to the inf. epigastric a.)
Course of the sac	the sac enters the inguinal canal through the deep inguinal ring, passes forwards & medially then comes out through the superficial inguinal ring	the sac pushes the inguinal triangle directly forwards (either med. or lat to the med. umbilical fold) to enter the med. part of the inguinal canal & may reach the superficial ing. ring.
relation to the spermatic cord.	the hernial sac lies <u>infront</u> of the spermatic cord & may reach the scrotum.	the hernial sac lies <u>behind</u> the spermatic cord & does not reach the scrotum.
Coverings of the hernial sac	(1) extraperitoneal fatty tissue. (2) internal spermatic fascia. (3) cremasteric muscle & fascia. (4) External spermatic fascia. (5) superficial fascia & skin.	(1) extra peritoneal fatty tissue. (2) fascia transversalis (3) cremasteric m. & fascia (if the hernia is lat. to the med. umbilical fold) or conjoint tendon (if the hernia is med. to the fold). (4) external spermatic fascia. (5) superficial fascia & skin.
shape	the hernial bulging is piriform (elongated).	the hernial bulging is globular.

Differences between inguinal hernias & femoral hernia

	inguinal hernia	Femoral hernia
incidence	more common in males (due to wider inguinal canal).	more common in females due to wider femoral ring)
Exit of the hernia	-through the deep ring (in oblique hernia) -through the inguinal △ (in direct hernia).	through the femoral ring then descends into the femoral canal.
site of the neck	lies above the inguinal lig.	lies below the inguinal lig.
site of the hernial sac	lies above the pubic tubercle	lies below the pubic tubercle.

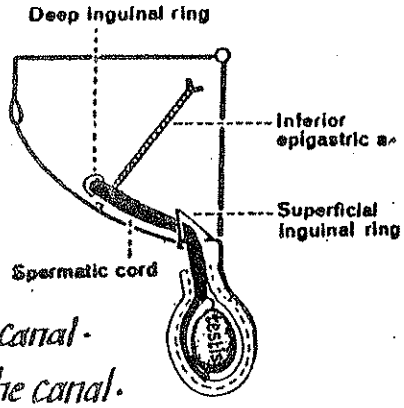
Male external genital organs

the male external genital organs include : (1) spermatic cord (2) scrotum
(3) testis & epididymis (4) penis .

1- Spermatic cord

* **Definition** : it is the group of structures (vas deferens, vessels, nerves & lymphatics) dragged by the testis as it descends into the scrotum.

* **Site**: it extends from the deep inguinal ring to the lower end of the testis lying partly in the inguinal canal & partly in the scrotum.



* **Relations**:

(A) - inside the inguinal canal :

- anteriorly : the ant. wall of the canal.
- posteriorly : the post. wall of the canal.
- superiorly : the roof of the canal
- inferiorly : the floor of the canal + the ilioinguinal nerve.

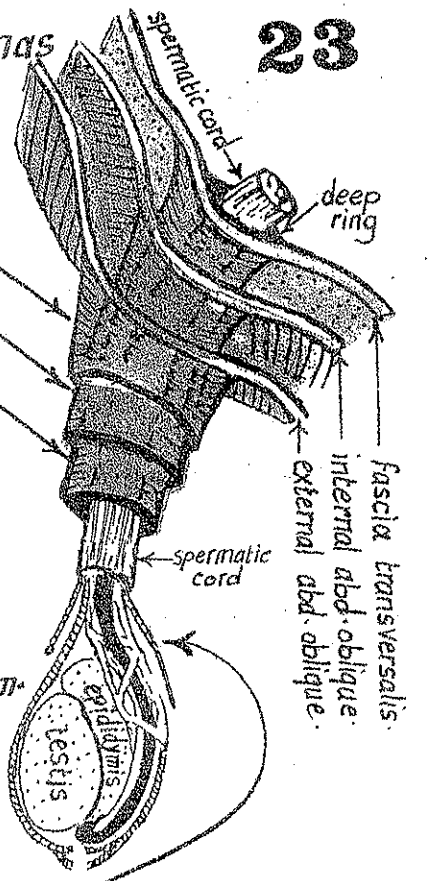
(B) outside the inguinal canal :

- anteriorly : skin, fascia & superficial external pudendal a.
- posteriorly : tendon of adductor longus + deep ext. pudendal a.

Coverings of the spermatic cord: the spermatic cord has

3 coverings arranged from outside inwards as follows:

(1) external spermatic fascia
(2) Cremasteric muscle & fascia
(3) internal spermatic fascia



) Internal Spermatic fascia: (the innermost coat):

it is derived from the fascia transversalis & is prolonged over the spermatic cord at the deep inguinal ring.

) Cremasteric muscle & fascia: (the middle coat):

derived from the internal abd. oblique m. & is prolonged over the cord as it passes below the lower arching fibres of internal oblique m.

) External Spermatic fascia: (the outermost coat):

derived from the external oblique aponeurosis & is prolonged over the cord at the superficial inguinal ring.

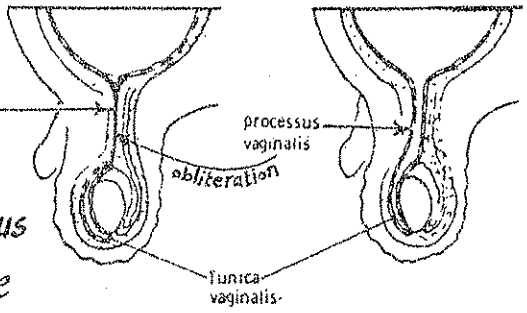
Constituents of the spermatic cord:

(A) 3 structures:
- (1) the vas deferens.
- (2) pampiniform plexus of veins.
- (3) lymphatic vessels.

(B) 3 Arteries:
- (1) testicular a. (br. from the abd. aorta).
- (2) artery of vas (br. from the inf. vesical a.).
- (3) Cremasteric a. (br. from the inf epigastric a.).

(C) 3 nerves:
- (1) sympathetic nerve fibres
- (2) cremasteric n. (genital br. of genitofemoral n.).
- (3) ilio inguinal n.

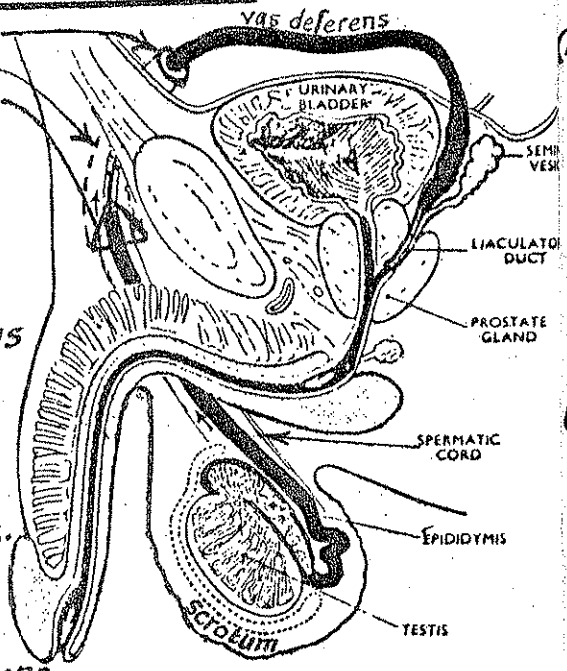
(D) Vestigue of the processus Vaginalis:



it is a fibrous band representing the obliterated processus vaginalis of the embryo (an embryoinc duct traversing the inguinal canal & connecting the peritoneal cavity above with the scrotal cavity called tunica vaginalis below).

Comment on the Constituents of the Spermatic Cord

(1) The Vas deferens:



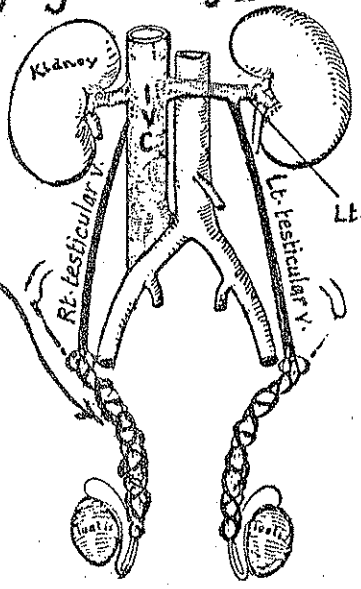
* **begins**: in the scrotum as a continuation to the tail of the epididymis.
* **ends**: in the pelvis by joining the duct of the seminal vesicle to form the ejaculatory duct which opens into the prostatic urethra.
* **Characters**: (1) it is 45 cm. long.
  (2) it is firm cord-like structure having a thick muscular wall & a narrow lumen.
* **Course & relations:**

(A) **In the scrotum**: it ascends behind the testis along the med. side of the epididymis.

(B) **In the Inguinal Canal**: it enters the superficial inguinal ring, runs among the constituents of the spermatic cord (post. in position) then it leaves the spermatic cord at the deep inguinal ring & hooks around the inf. epigastric a.

(C) **In the pelvis**: see pelvis.

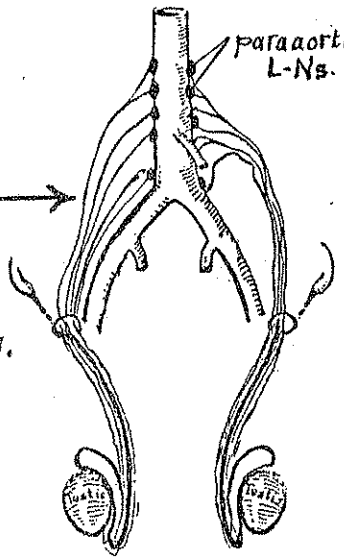
(2) Pampiniform plexus of veins:



- it is a plexus formed by several veins that drain the testis & epididymis (it forms the main bulk of the spermatic cord).
- at the deep inguinal ring, the veins of the plexus unite to form the testicular vein.
- the Rt. testicular v. ends in the inf. vena cava (at acute angle).
- the Lt. " " " " " Lt. renal vein (at right angle).

N.B: abnormal dilation & tortuosity of the veins of the plexus is called **Varicocele**. It is more common on the Lt. side.

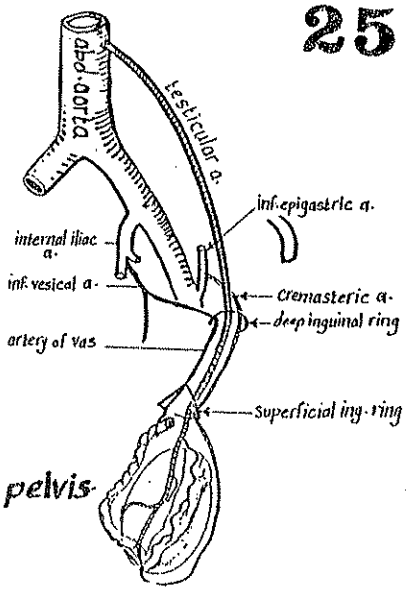
(3) Lymphatic vessels:



- they drain the testis & epididymis.
- they accompany the testicular vessels to the abdomen.
- they end in the para-aortic lymph nodes alongside the abdominal aorta.

N.B: the lymphatics of the scrotum & penis drain into the

(4) Testicular a. :



- arises from the abd. aorta opposite L3.
- descends on the post. abd. wall, enters the deep ing. ring & runs in the spermatic cord down to the testis.
- it supplies the testis & anastomoses with the cremasteric a. & the artery of the vas.

(5) artery of the vas deferens :

- arises from the inf. vesical a. (br. of int. iliac a.) inside the pelvis.
- it accompanies the vas deferens in the spermatic cord.
- it supplies the vas & the epididymis.

(6) Cremasteric a. :

arises from the inf. epigastric a. & accompanies the spermatic cord supplying its coverings.

(7) Cremasteric n. : (genital br. of genitofemoral n.) :

it supplies the cremasteric m. then traverses the inguinal canal to supply the skin of the ant. ⅓ of the scrotum.

(8) Sympathetic fibres :

- arise from the renal & the aortic plexuses & surround the testicular a. to reach the testis.

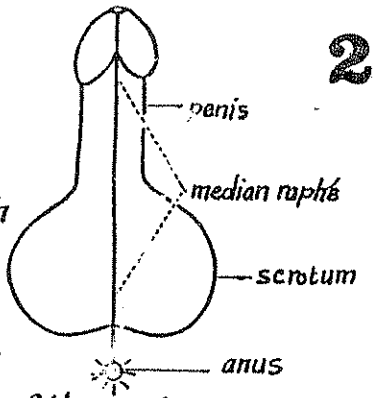
(9) Ilioinguinal nerve :

- arises from the lumbar plexus (from L1).
- enters the inguinal canal by piercing its post. wall.
- emerges from the superficial ring to supply the skin of the external genitalia.

(10) Vestigue of the processus vaginalis : see page 23

N.B : In the female, the spermatic cord is replaced by the round lig. of uterus which is derived from the gubernaculum of the foetus. It ends below by getting attached to the superficial fascia of the labium majus. As it passes through the inguinal canal it acquires coverings corresponding to those of the spermatic cord but they are thin & adherent to its wall.

II- The Scrotum



* **Definition**: it is a cutaneous bag containing the 2 testes, epididymes & the lower parts of the spermatic cords of both sides. It corresponds to the labia majora of females.

* **Features**: externally, it is divided into Rt. & Lt. portions by a median raphé which is continued to the undersurface of the penis.

N.B: the Lt. portion usually hangs lower than the Rt. portion.

* Layers of the Scrotum:

the scrotal wall is formed of the following layers (from outside inwards):

(1) **Skin** brown in colour, thin & rugose

(2) **dartos muscle**: replaces the fatty layer of S. fascia it is a thin layer of involuntary m. fibres adherent to the skin. It sends an inward septum in the middle line dividing the scrotal cavity into 2 compartments for the 2 testes. It is supplied by sympathetic fibres & is responsible for the rugosity of the overlying skin.

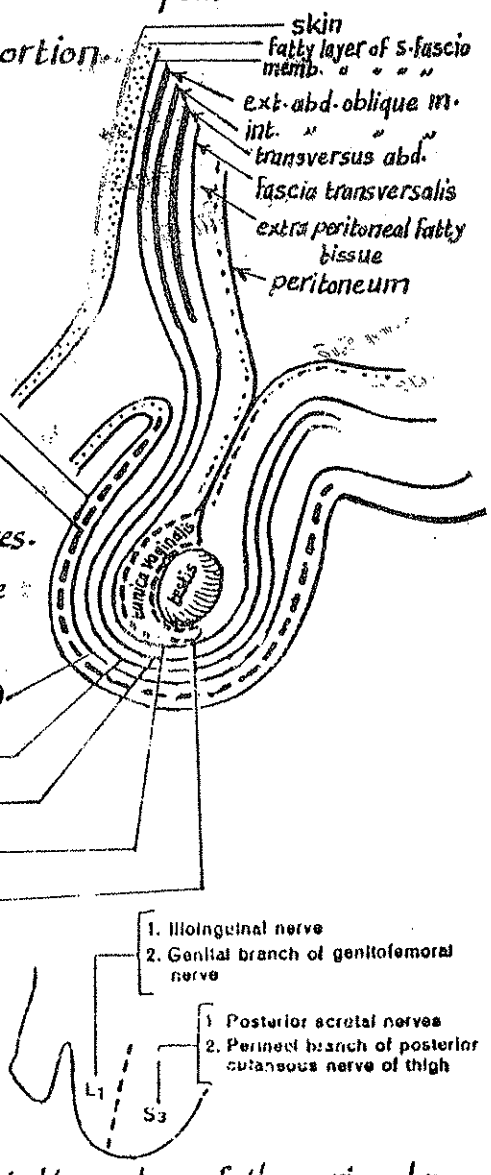
(3) Membranous layer of superficial fascia (Colles fascia)

(4) External spermatic fascia

(5) Cremasteric muscle & fascia

(6) internal spermatic fascia

(7) parietal layer of the tunica vaginalis



* Nerve supply of the Scrotum:

(a) the ant. 1/3 is supplied by L1 through the ilioinguinal n. & the genital br. of genitofemoral n.

(b) the post. 2/3 is supplied by S3 through the post. scrotal branches of the perineal n. & the perineal br. of the post. cutaneous n. of the thigh.

* Blood Supply:

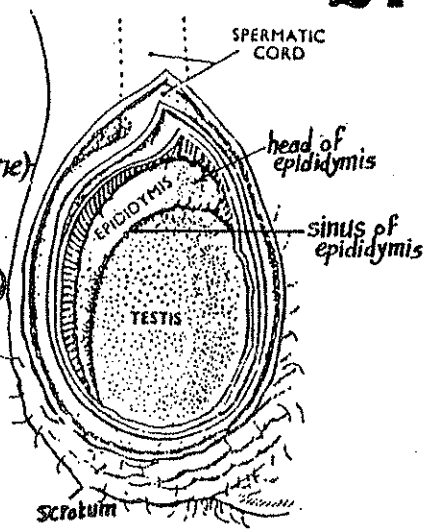
(1) Superficial & deep external pudendal arteries (from femoral a.).

(2) post. scrotal branches of internal pudendal a. (br. of internal iliac a.).

(3) Cremasteric a.: from inf. epigastric a.

* **Lymphatic drainage**: into the superficial inguinal lymph nodes.

III- The testis



* **Definition**: it the male primary sex organ. It is a mixed gland producing ↗ exocrine secretions (the sperms).
  ↘ endocrine secretions (testosterone hormone)
* **Site**: it is located in the scrotum where the temperature is less than 37°c (which is essential for spermatogenesis). Each testis lies in one scrotal compartmed suspended by the spermatic cord.
* **Shape & size**: it is oval in shape (compressed from side to side) it is $1\frac{1}{2}$" long, 1" broad (from before backward & 3/4" thick (from side to side).
* **External features**: it has 2 poles (upper & lower), 2 borders (ant. & post) & 2 surfaces (med. & lat.).
  - the 2 poles are convex & smooth. The upper pole provides attachment to the spermatic cord.
  - the ant. border is smooth, convex & covered with tunica vaginalis.
  - the post. border is straight & related to the epididymis (laterally) & the vas deferens (medially).
  - the 2 surfaces are covered by tunica vaginalis. The post. part of the lat. surface is separated from the epididymis by a groove called sinus of epididymis.
* **Coverings of the testis**: the testis has 9 coverings as follows (from inside outwards:

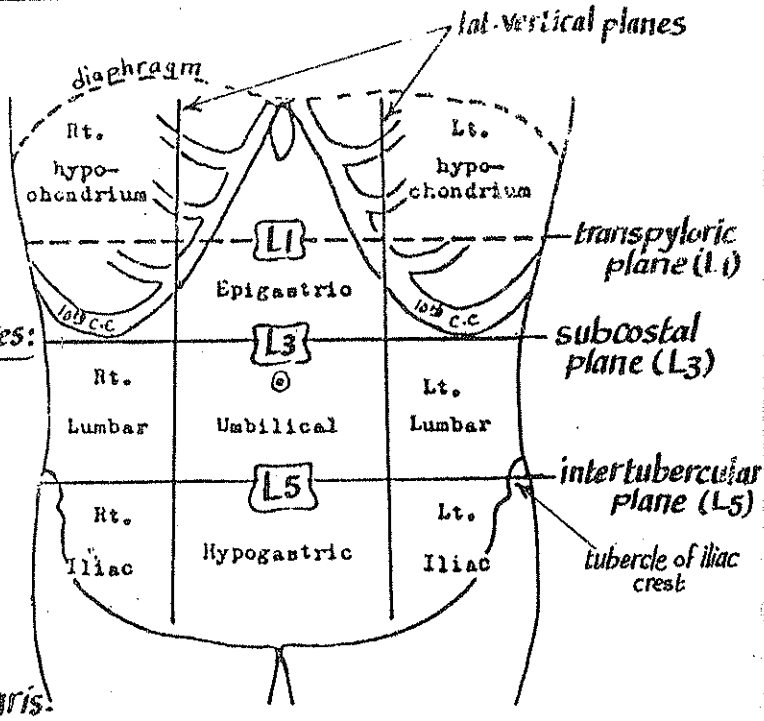
3 special coats	3 coats from the abd. wall	3 cutaneous & subcutaneous coats
(1) tunica albuginea (fibrous capsule)	(4) internal spermatic fascia	(7) memb. layer of superficial fascia
(2) visceral layer of tunica vaginalis	(5) cremasteric muscle & fascia	(8) dartos muscle
(3) parietal " " " "	(6) external spermatic fascia	(9) skin

The Epididymis

* It is a comma shaped body attached to the posterolateral aspect of the testis.
* **Structure**: it is formed of highly coiled single tube (6 meters long) tightly puckered in fibrous tissue.
* **parts**:
  (1) head: the expanded upper end which is connected to the upper pole of the testis by efferent ductules.
  (2) body: is the central portion made up of the single coiled tube.
  (3) tail: is the lower pointed end attached to the lower pole of the testis. It is continuous with the vas.
* **Arterial supply of testis & epididimis**: testicular a. & artery of the vas
* **Venous drainage** " " " : pampiniform plexus of veins } see constituents of spermatic cord
* **Lymphatic** " " " " : into para aortic lymph nodes
* **N. supply**: sympathetic fibres from the renal & aortic plexuses

The Abdominal Cavity

* The planes of the abdomen:



(I) Transpyloric plane:

* it lies midway between the suprasternal notch & the symphsis pubis.
* it passes through the following structures:

(1) Pylorus of stomach.
(2) beginning of the duodenum.
(3) Fundus of the gall bladder.
(4) the body of the pancreas.
(5) the origin of the sup. mesenteric a.
(6) the upper end of the linea semilunaris.
(7) the body of the 1st lumbar vertebra. (8) the tip of the 9th costal cartilage.

(II) Subcostal plane:

* it is a transverse plane drawn at the level of the lowermost limit of the costal margin
* it cuts: (1) the body of the 3rd lumbar vertebra (2) the 10th costal cartilage.

(III) Intertubercular plane:

* it is a transverse plane passing through the tubercles of the iliac crests.
* it cuts the body of the 5th lumbar vertebra.

(IV) Lateral vertical planes (Rt. & Lt.):

2 vertical planes drawn from the midinguinal points below to the midclavicular points abov

Regions of the abdomen

* the abdomen is divided, for descriptive purposes into 9 regions by 4 planes:
  - 2 horizontal planes: the subcostal plane & the intertubercular plane.
  - 2 vertical planes: the Rt. & Lt. lat. vertical planes.
* the 9 abdominal regions are:

(1) Rt. hypochondrium	(2) epigastrium	(3) Lt. hypochondrium
(4) Rt. lumbar	(5) umbilical	(6) Lt. lumbar
(7) Rt. iliac	(8) hypogastrium	(9) Lt. iliac

The Peritoneum

Definition: it is a large serous sac which lines the abdominal cavity & covers -to different degrees- the abdominal viscera.

Formation:

(1) the peritoneum develops as a closed sac which lines the abdomen.

(2) the abdominal organs develop & grow on the post. abd. wall outside the peritoneal cavity.

(3) as the abdominal organs increase in size they project forwards & push the peritoneum (invaginate it) to variable degrees :

(a) organs which do not need free movement (eg kidneys & ureters) will push the peritoneum over the post.-abd.-wall slightly so, their ant.-surfaces only become covered with peritoneum.

(b) organs which need free movements (e.g the stomach & intestine) will project more till they become completely covered with peritoneum & hang from the post.-abd.-wall by a sheet formed of 2 layers of peritoneum called mesentery.

(4) the peritoneum is now converted into 2 layers :

(a) a layer which lines the walls of the abd.-cavity & called the **parietal peritoneum**.

(b) " " " covers the abd.-organs & called the **visceral peritoneum**.

(5) the space between the 2 layers becomes very much reduced (due to the enlargement of the abd.-organs) & becomes converted into a potential space "**peritoneal cavity**" containing a little amount of lubricating serous fluid.

Functions of the peritoneum:

(1) it provides slippery surfaces for free movements of the abdominal viscera.

(2) protection of the viscera: the peritoneal membrane contains various phagocytic cells which guard against infections.

(3) healing power: the mesothelial cell of the peritoneal membrane can transform into fibroblasts which promote healing of the abdominal wounds.

(4) storage of fat : peritoneal folds are capable of storing large amounts of fat.

Sex differences:

(1) Male peritoneum is a closed sac.

(2) Female peritoneum is an open sac (communicates with the exterior through the uterine tubes.

Subdivisions of the peritoneal Cavity

* The general peritoneal cavity is divided into 2 sacs:

(1) greater sac (2) lesser sac

* the 2 sacs communicate together at the epiploic foramen (opening into lesser sac).

1- Greater sac of peritoneum:

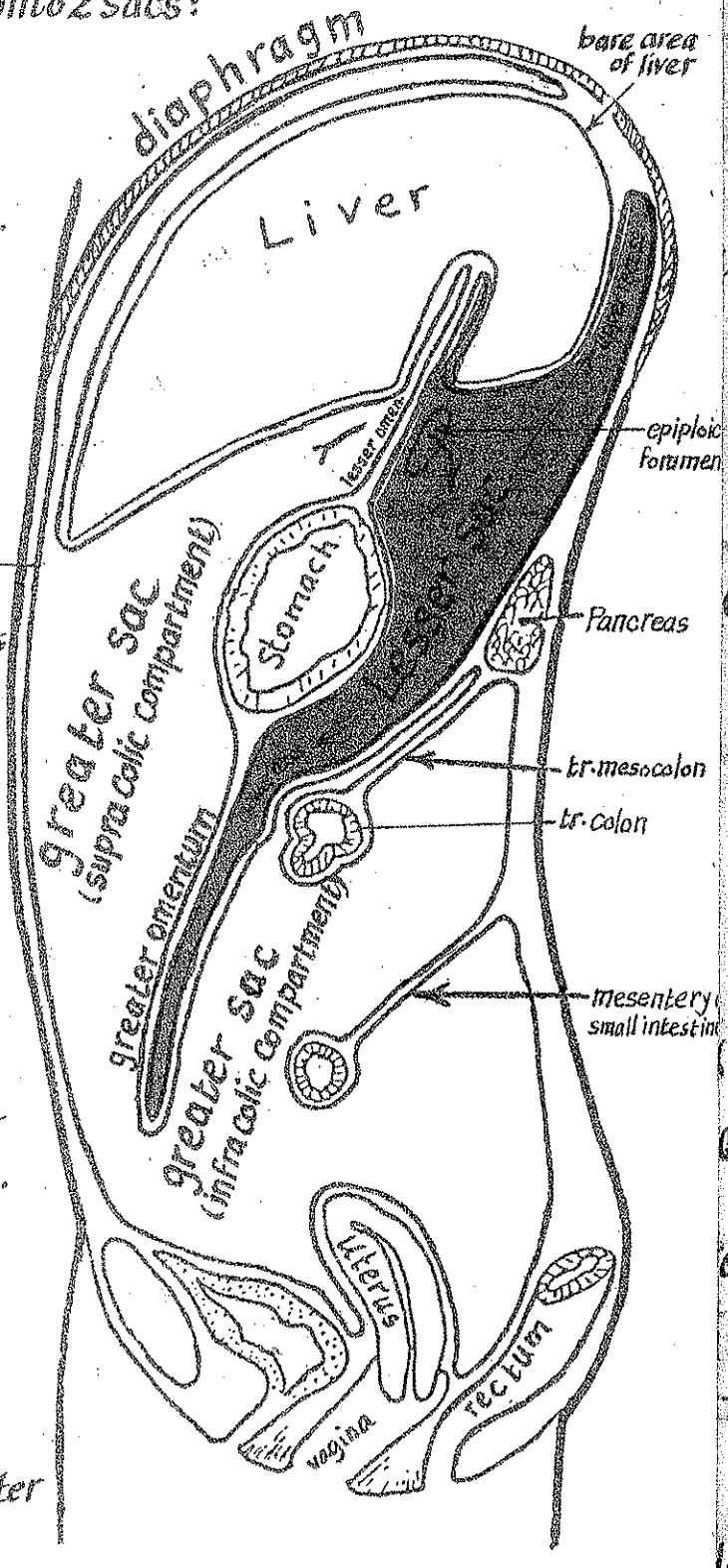
* it is the part of the peritoneal cavity which is exposed by opening the parietal peritoneum of the ant. abd. wall

* it is incompletely divided into 2 compartments (supra colic & infra colic compartments) by a partition formed of:

(1) lesser omentum (2) Stomach

(3) greater omentum.

(4) transverse colon & tr. mesocolon.



(A) The Supracolic Compartment:

- it is the antero superior part of the greater sac (lies above & infront of the partition).
- it is divided into Rt. & Lt. parts by the falciform lig. of the liver.

(B) The Infracolic Compartment:

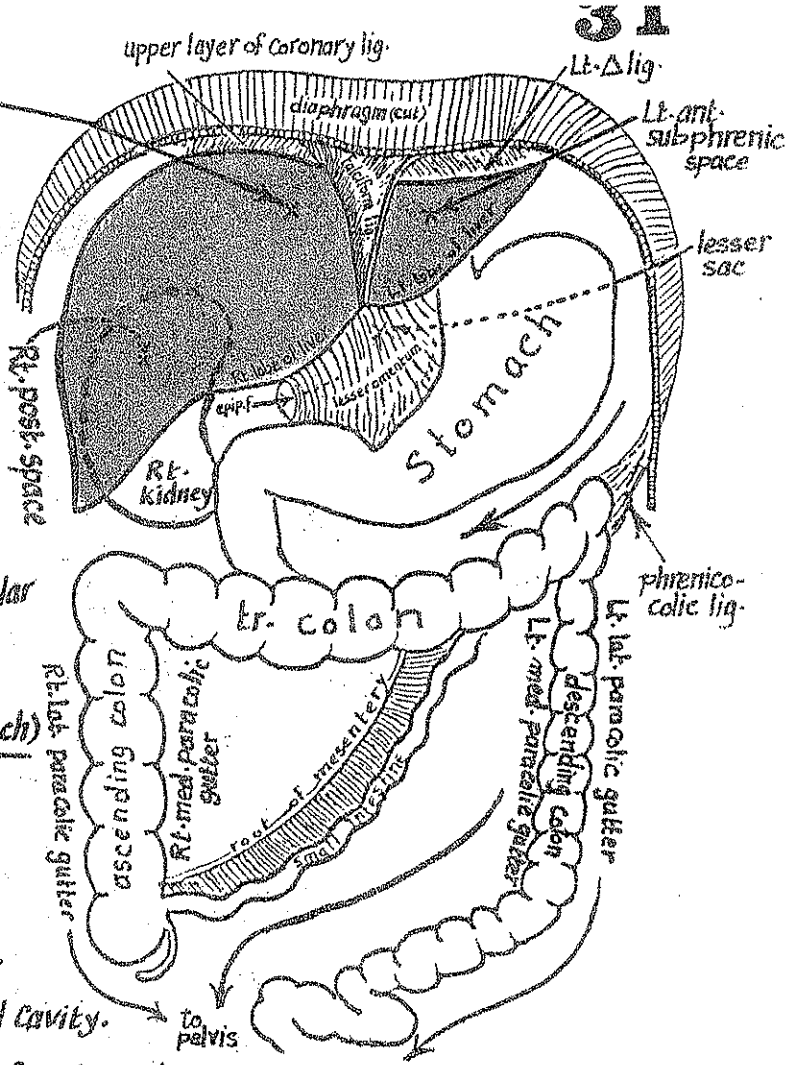
- it is the postero inferior part of the greater sac (lies below & behind the partition).
- it is subdivided by the mesentery of the small intestine into ↗ upper Rt. region. ↘ lower Lt. region.
- the lower Lt. region communicates freely with the pelvic cavity.

Subphrenic spaces

* Definition: they are potential spaces lying below the diaphragm in relation to the liver, the falciform lig. & the abd. wall. They may be sites of collection of pus forming a sub-phrenic abscess

(1) Rt. anterior subphrenic space:
- lies between the Rt. lobe of the liver & the diaphragm on the Rt. side of falciform lig.
- it is closed posteriorly by the upper layer of coronary lig. & the Rt. triangular lig.

(2) Lt. anterior subphrenic space:
- lies between the Lt. lobe of the liver & the diaphragm on the Lt. side of falciform lig.
- it is closed posteriorly by the Lt. triangular ligament.



(3) Rt. post. subphrenic space (Morison's pouch)
- boundaries:
  - anteriorly: inf. surface of Rt. lobe of liver.
  - posteriorly: ant. surface of the Rt. kidney.
  - superiorly: lower layer of the coronary lig.
  - inferiorly: opens into the general peritoneal cavity.
- importance: it is the most dependent part of peritoneal cavity in the supine position & is the commonest site for subphrenic abcess & accumulation of fluid effusions.

(4) Lt. post. subphrenic space (Lesser sac of peritoneum): see page 32.

(5) Rt. extraperitoneal subphrenic space: between the bare area of the liver & the diaphragm. it is bounded between the upper & lower layers of the coronary lig.

(6) Lt. extraperitoneal subphrenic space: lies around the Lt. suprarenal gland & the upper pole of the Lt. kidney.

N.B: the Rt. & the Lt. extraperitoneal space are shut off the general peritoneal cavity.

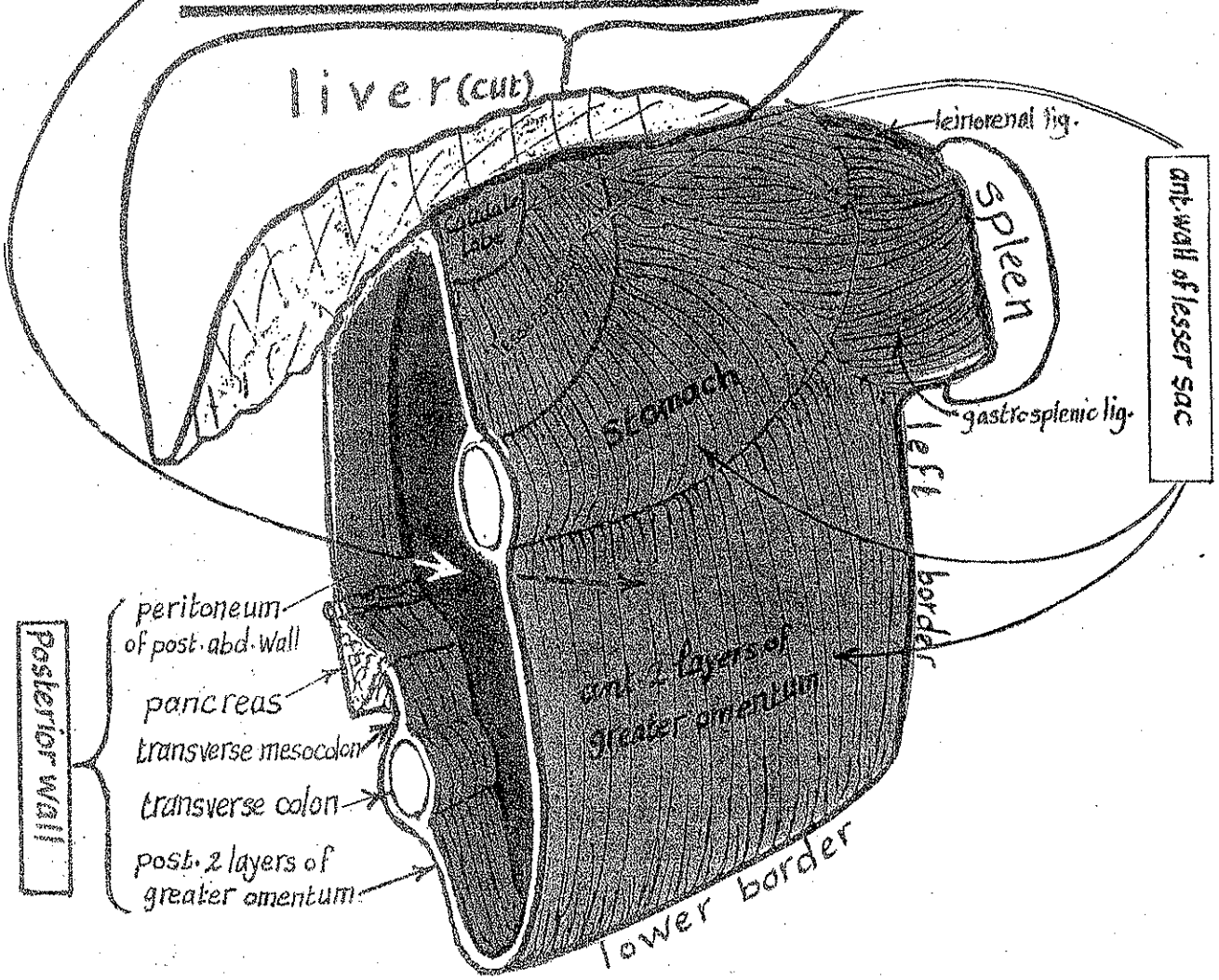
Para-colic Gutters

Definition: these are longitudinal grooves lying along side the ascending & descending colons. They may transmit pus between the different parts of peritoneal cavity in peritonitis.

Classification: paracolic gutters include:

1) Rt. lat. paracolic gutter (lat. to ascending colon): it is the only gutter which is open above it communicates the Rt. ant. & post. subphrenic spaces above with the pelvic cavity below.
2) Rt. med. gutter (med. to ascending colon): it is closed both above & below (lies between the root of mesentery & the ascending colon).
3) Lt. lat. gutter (lat. to descending colon): it is closed above by the phrenicocolic lig. but open below.
4) Lt. med. gutter (med. " " "): closed above by Lt. colic flexure but open below into the pelvis.

Lesser Sac of peritoneum



* **Definition**: it is a large peritoneal recess which lies behind & beyond (above & below) the stomach. It is completely separated from the greater sac of peritoneum except for a single opening (the epiploic foramen).

* **Extension & recesses:**

(1) upwards: it extends behind the caudate lobe of the liver (upper recess).
(2) downwards: " " between the ant. 2 layers & post. 2 layers of greater omentum (lower reces
(3) to the left: " " to the hilum of the spleen between the gastrosplenic & lienorenal ligament
(4) to the right: the lesser sac is shut off the greater sac except at the epiploic foramen.

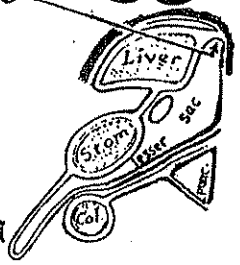
* **Boundaries of the lesser sac:**

(A) Ant. wall: (1) peritoneum on the caudate lobe of the liver.
(2) the lesser omentum (3) peritoneum on the back of the stomac
(4) the ant. 2 layers of the greater omentum.

(B) Post. wall: (1) post. 2 layers of the greater omentum.
(2) transverse colon & transverse mesocolon.
(3) peritoneum covering the ant. surface of the pancreas.
(4) peritoneum covering the post. abd. wall structures (behind the stom

Above: it is closed by reflection of peritoneum from the liver to diaphragm

Below: it is closed by folding of the greater omentum on itself.



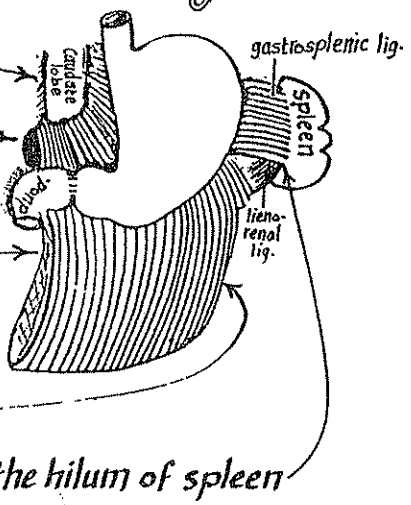
the Rt. border: is formed by:

(1) reflection of peritoneum from the Rt. margin of the caudate lobe to the post. abdominal wall

(2) the epiploic foramen

(3) reflection of peritoneum from the back of the 1st inch of duodenum onto the neck of of pancreas

(4) the Rt. margin of the greater omentum



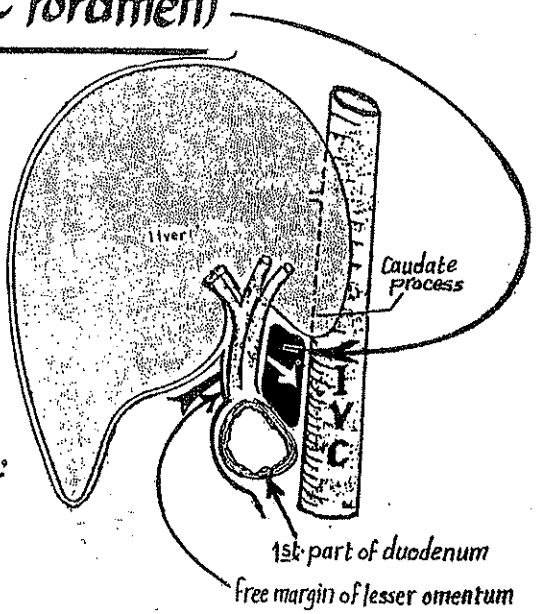
the Lt. border: is formed by:

(1) the left margin of the greater omentum

(2) the meeting of the gastrosplenic & lienorenal ligaments at the hilum of spleen

Development of the lesser sac: it develops as a pouch (diverticulum) which evaginates from the greater sac behind & beyond the stomach as a result of its rotation.

Opening into lesser sac (epiploic foramen)



Definition: it is a vertical slit like passage which communicates the greater sac & the lesser sac.

Site: it lies behind the Rt. free margin of lesser omentum at the level of T12 vertebra.

size: about 3 cm. long (admits 2 fingers).

Boundaries:

Anteriorly: the Rt. free margin of lesser omentum containing:
(1) portal vein (2) hepatic a. (3) common bile duct.

posteriorly: peritoneum covering the inf. vena cava.

superiorly: the caudate process of the caudate lobe of the liver.

inferiorly: peritoneum covering the 1st inch of duodenum, portal v. & hepatic a.

Clinical importance:

(1) a loop of small intestine may herniate through the epiploic f. (internal hernia).

(2) haemorrhage from the liver can be controlled by putting the index finger in the epiploic f. & compressing the hepatic a. (in the free margin of the lesser omentum) by the thumb.

Peritoneal Folds

* **Definition:** they are double layers of peritoneum connecting different abd. organs or connecting an organ to the abdominal wall.

* **Function:** (1) they attach organs to each other or to the abdominal wall.
(2) " allow free mobility to certain abdominal organs.
(3) " act as media for the passage of vessels, nerves & lymphatics to the suspended organs.

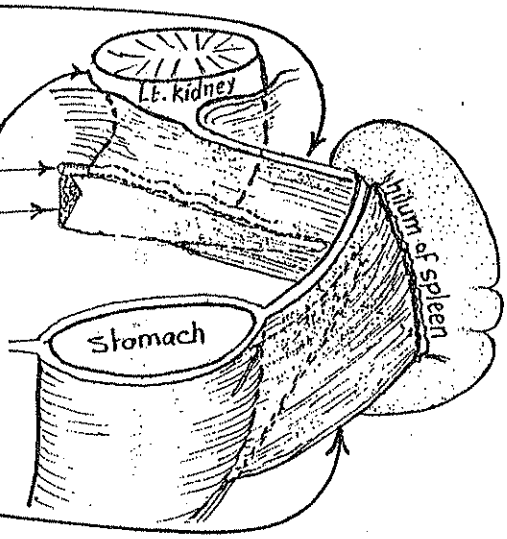
* **Classification:** peritoneal folds are arbitrarily classified into 3 types :

I- **omenta** : are peritoneal folds connecting the Stomach to other organs. They include:
(1) lesser omentum : between the stomach & the liver (page 62).
(2) greater omentum: " " " & transverse colon (page 35).
(3) gastro splenic omentum (or lig.) : between the stomach & spleen (see below).

II- **Mesenteries** : peritoneal folds connecting the mobile parts of the intestine to the post. abdominal wall. They include:
(1) the mesentery of the small intestine (page 48). (2) transverse mesocolon (p.35)
(3) Sigmoid mesocolon (p.56) (4) mesoappendix (p.51).

III- **Ligaments:** include the rest of the peritoneal folds which connect abd. organs together or to the abdominal wall.

Lienorenal ligament



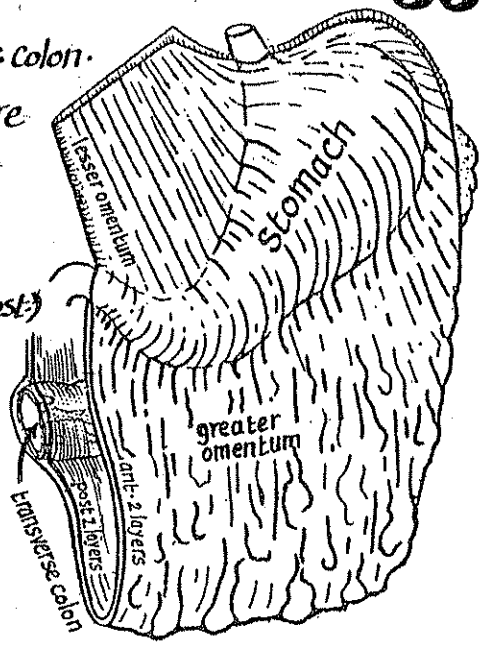
* **attachments:** it extends between:
(1) hilum of spleen (2) front of Lt. kidney
* **Contents:** (1) splenic vessels
(2) tail of the pancreas
(3) extraperitoneal fatty tissue.
(4) autonomic n. fibres (5) lympatics & L. Ns
* **Embryologically:** it is a part of dorsal mesogastrium.

Gastrosplenic lig. (omentum)

* **Attachments:** it stretches between : (1) upper part of greater curvature of stomach.
(2) the hilum of the spleen.
* **Contents:** (1) short gasric vessels (2) Lt. gastro-epiploic vessels.
(3) Lymph vessels & lymph nodes (pancreatico splenic L. Ns).
(4) autonomic n. fibres (5) extraperitoneal fatty tissue.
* **Embryologically:** it is a part of the dorsal mesogastrium.

Greater Omentum

It is a peritoneal fold connecting the stomach to the tr. colon.
it descends as an apron from the greater curvature of the stomach to cover the intestine (separating it from the ant. abdominal wall).



***Structure** : it is made up of 4 layers (2 ant. & 2 post.)
The 4 layers are usually fused together forming a thin fenestrated membrane containing variable amounts of fat.

***Attachments:**

- the ant. 2 layers are attached above to the greater curvature of stomach & the 1st inch of duodenum. They descend for a variable distance then fold back upon themselves becoming post. 2 layers.
- the post. 2 layers : ascend infront of the small intestine to reach the transverse colon where they become adherent to the front of the tr. colon & tr. mesocolon to reach the ant. border of the body of pancreas.

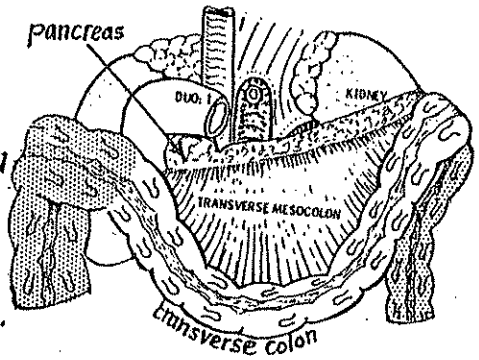
***Contents:**

(1) Rt. & Lt. gastroepiploic vessels
(2) Rt. gastroepiploic L.Ns & lymph vessels } along the greater curvature of stomach.
(3) autonomic nerve fibres (4) extraperitoneal fatty tissue.

***Functions :**

(1) heat insulator covering the intestine (2) reservior of fat
(3) defensive function : it contains fixed macrophages which can be mobilized as free macrophges. It also moves towards inflamed abd. organs to surround them & prevent the spread of inflammation (policeman of abdomen).

Transverse Mesocolon



* it is a broad peritoneal fold enclosing the transverse colon (in its free margin) & suspending it to the upper part of the post. abd. wall.

***Attachments** : its root is attached to the front of the head. & the ant. border of the body of pancreas.

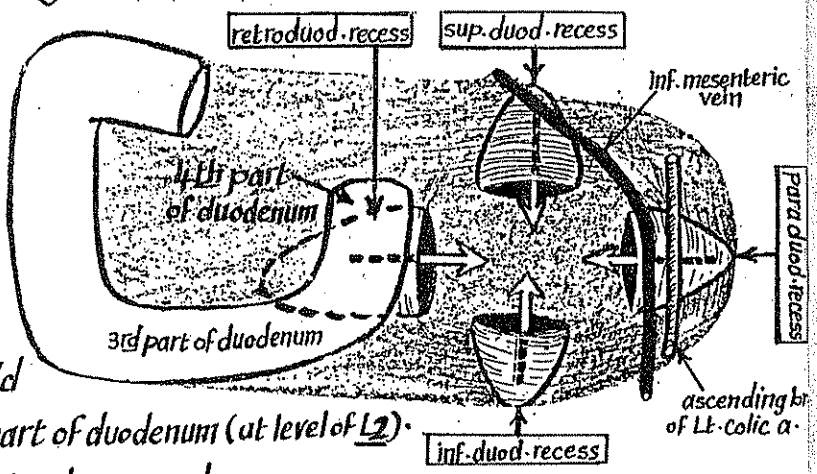
***Contents** : (1) transverse colon (in the free margin).
(2) middle colic vessels & their branches (3) lymphatics & L.Ns.
(4) autonomic n. fibres (5) extra peritoneal fatty tissue.

Peritoneal recesses 36

* **Definition**: these are small pockets or pouches of peritoneal cavity enclosed by small inconstant peritoneal folds.
* **Sites**: they commonly occur at the transitional zones between the absorbed & unabsorbed parts of the mesentery (i.e functional zones between the fixed & mobile parts of the intestine). They are mainly found in relation to the duodenum, Caecum & sigmoid colon.
* **Characters**: they are best observed in the newly born & frequently become obliterated in the adults.
* **Clinical importance**:
  (1) when they persist in the adult, they become possible sites of internal hernia.
  (2) the peritoneal folds overlying these recesses may be related to blood vessels (liable to injury during surgical operations).
* **Classification**:

(A) Duodenal recesses:

there are 4 recesses related to the 4th part of the duodenum:



(1) sup. duodenal recess:
- it underlies the sup. duodenal fold on the Lt. side of upper end of 4th part of duodenum (at level of L2).
- it is 2 cm. deep & its orifice looks downwards.
- its overlying fold is related to the inf. mesenteric vein.

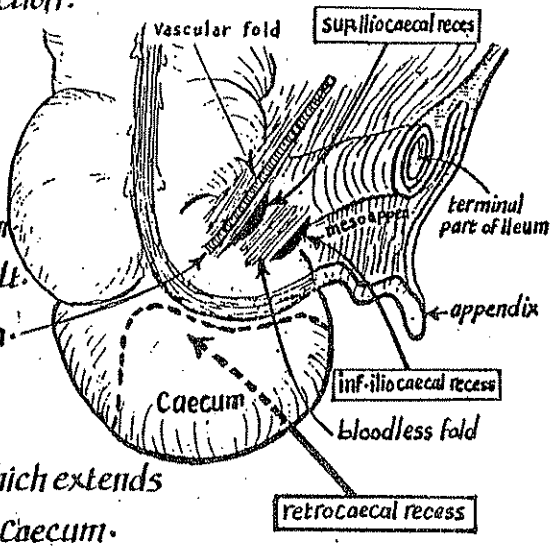
(2) inf. duodenal recess:
- it underlies the inf. duodenal fold on the Lt. side of lower end of 4th part of duod. (at level of
- it is 3 cm. deep & its orifice looks upwards.
- its overlying fold is not related to vessels.

(3) paraduodenal recess:
- it underlies the paraduodenal fold on the Lt. side of the whole 4th part of duodenum.
- its orifice looks to the right.
- its overlying fold is related to: inf. mesenteric vein, ascending br. of Lt. Colic artery.

(4) Retroduodenal recess:
- it underlies the 4th & 3rd parts of the duodenum.
- it is the largest of all duodenal recesses (8-10cm deep) & lies infront of the abd. aorta.
- its orifice looks to the left.

(B) Caecal recesses:

there are 3 recesses related to the ileocaecal junction:



(1) superior ileocaecal recess:

- lies undecover of the vascular fold of Caecum which extends from the lowermost part of the mesentery of small intestine to the front of caecum
- the orifice of the recess looks downwards & to the Lt.
- the overlying vascular fold contains ant. caecal a.

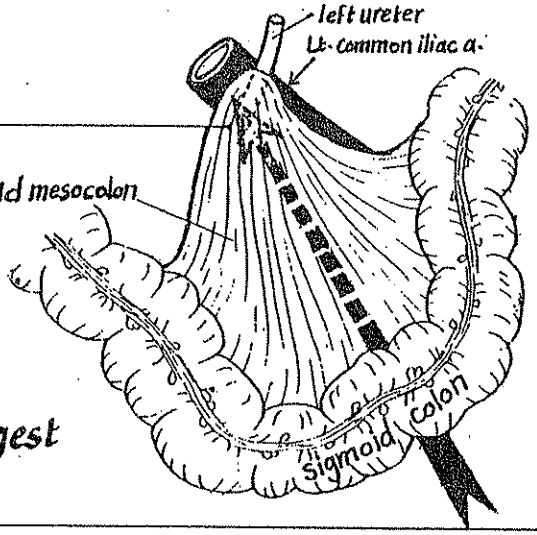
(2) Inferior ileocaecal recess:

- lies undercover of the bloodless fold of Treves which extends from the terminal end of ileum to the front of Caecum.
- the orifice of the recess looks downwards & to the Lt.

(3) Retrocaecal recess:

- lies behind the caecum & may extend upwards behind the ascending colon.
- this recess lodges the appendix in 74% of cases.
- the orifice of the recess looks downwards.

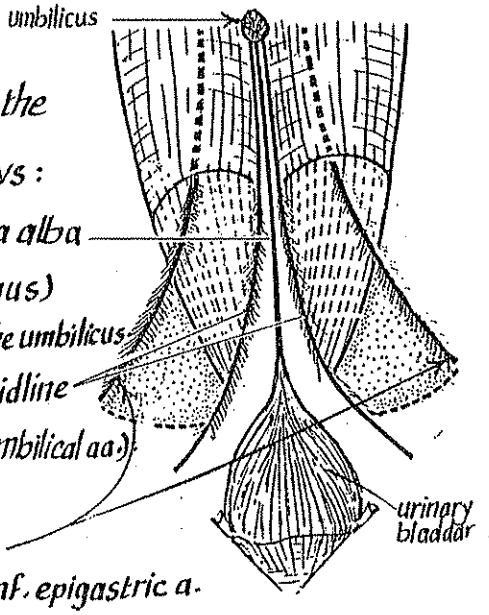
(C) Intersigmoid recess:



- lies behind the apex of the V-shaped sigmoid mesocolon (where the Lt. ureter crosses the end of Lt. common iliac artery.
- its orifice looks downwards.

N.B: the lesser sac may be regarded as the largest peritoneal recess.

Umbilical folds



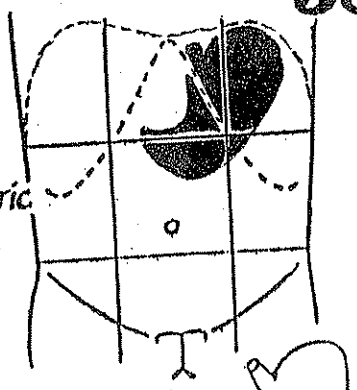
they include 5 peritoneal folds lying on the inner surface of the ant. abd. wall & converge towards the umbilicus as follows:

(1) Median umbilical fold: lies in the middle line behind linea alba
It is raised by the median umbilical lig. (obliterated urachus) which extends from the apex of the urinary bladder to the umbilicus

(2) Medial umbilical folds (Rt. & Lt.): lying on each side of midline
they are raised by the lat. umbilical ligaments (obliterated umbilical aa.) which extend from the side of the pelvis to the umbilicus

(3) Lateral umbilical folds (Rt. & Lt.) lying lat. to the med. folds
Each fold is raised by an inf. epigastric a.

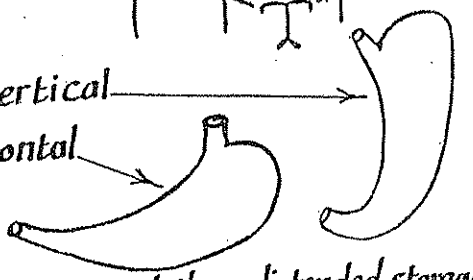
Stomach



* It is the widest & most distensible part of the G.I.T.
* **Site**: it lies obliquely in the left hypochondrim, epigastric & umbilical regions.

* **Shape:**

(1) J-shaped (commonest shape) : its long axis is vertical
(2) Steer (ox) horn (less common) : its long axis is horizontal



N.B: the shape of the stomach depends on:

(a) the degree of its distension: the empty stomach is more vertical than distended stomach
(b) the body built : it is more horizontal in short obese individuals.
(c) the phase of respiration : it is more vertical with inspiration
(d) the position of the body : it is more vertical in the standing position

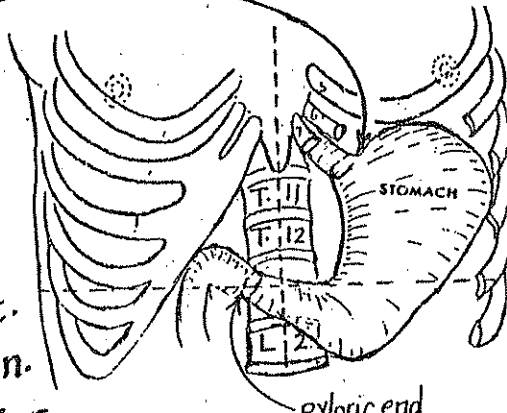
* **Size**: the stomach is a very distensible organ. Its mean capacity is 2 liters in adult

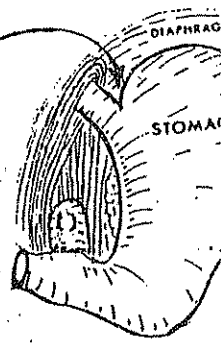
* **External features**: the stomach has
  (a) 2 orifices : cardiac & pyloric.
  (b) 2 borders : lesser & greater curvatur
  (c) 2 surfaces : anterosuperior & posteroinfe
  (d) 3 parts : fundus, body & pyloric pa

(A) Orifices of the Stomach:

(1) **Cardiac orifice or end** (the more fixed end):

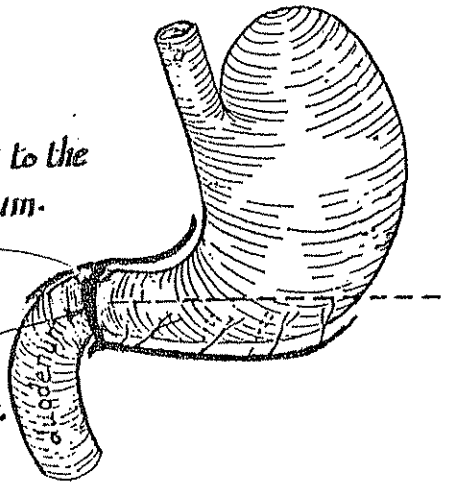
* **Site**: in the upper part of the epigastrium at the junction with the oesophagus. It lies behind the Lt. 7th costal cartilage one inch from the median plane & 4 inches deep to the ant. abdominal wall.
* **relations**: - anteriorly: Lt. lobe of the liver & ant. gastric n. - posteriorly: diaphragm & post. gastric n.
* **Sphincter**: it has no true anatomical sphincter. The gastro-oesophageal junction closes by a physiological sphincter which depends on:
  (1) the acute angle at which the oesophagus joins the stomach
  (2) the sphincteric action of the fibres of the Rt. crus of diaphragm which encircle the lower end of the oesophagus
  (3) the thick mucosal folds at the lower end of the oesophagus.





acts as a mucosal valve which closes the lumen of the lower end of oesophagus.
) Contraction of the circular muscle fibres in the lower end of the oesophagus prevents the regurgitation of the gastric contents.

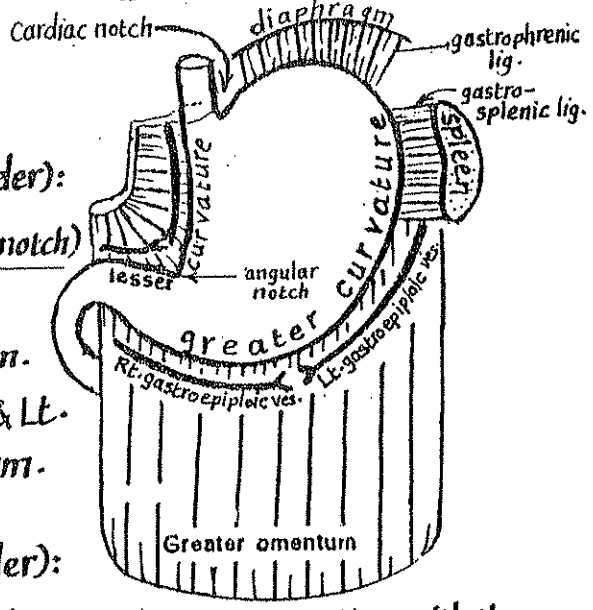
I) Pyloric orifice or end (the less fixed end):



* Site: it lies in the transpyloric plane (L1) ½ an inch to the Rt. of the median plane at the junction with the duodenum.
Its position is indicated by:
(1) circular groove (pyloric constriction)
(2) prepyloric v. of Mayo (seen only in the living) connecting the Rt. gastric v. with the Rt. gastroepiploic v.
(3) feeling the thickness of the pyloric sphincter.

* Relations :- anteriorly : quadrate lobe of liver - posteriorly : neck of pancreas.
* Sphincter : it has a true anatomical sphincter (thickening of the circular muscle layer).

3- Borders of the Stomach:



(1) Lesser curvature (Rt. Concave border):

- Its lowermost part presents a notch (angular notch)
- Relations:
(1) it gives attachment to the lesser omentum.
(2) it is related to the Lt. & Rt. gastric vessels & Lt. gastric L.Ns. which run in the lesser omentum.

(2) Greater Curvature (Lt. Convex border):

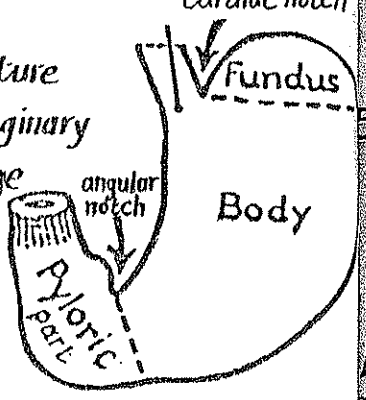
- At its beginning it presents a notch (cardiac notch) at its junction with the lower end of the oesophagus. Its uppermost part constitutes the fundus.
- Relations:
(1) it gives attachment to 3 ligaments (From above downwards):
(a) gastrophrenic lig.: extending from the fundus to the diaphragm.
(b) gastrosplenic lig.: extending from the upper part of the greater curvature to the hilum of the spleen.
(c) greater omentum: extends from the lower part of the greater curvature.
(2) it is related to the Rt. & Lt. gastroepiploic vessels & the gastroepiploic L.Ns. which lie parallel to the greater curvature between the 2 layers of the greater omentum.

* Parts of the stomach:

(1) **Fundus**: is the dome-shaped part above the horizontal line joining the cardiac orifice to the greater curvature

(2) **Body**: extends from the level of the cardiac notch to an imaginary line between the angular notch to a corresponding bulge on the greater curvature.

(3) **Pyloric portion**: distal to the imaginary line & consists of
- (a) pyloric antrum: the dilated part below the body.
- (b) " canal: the distal narrow 1" of the stomach.
- (c) " sphincter: the distal end of the stomach.



* Surfaces of the stomach:

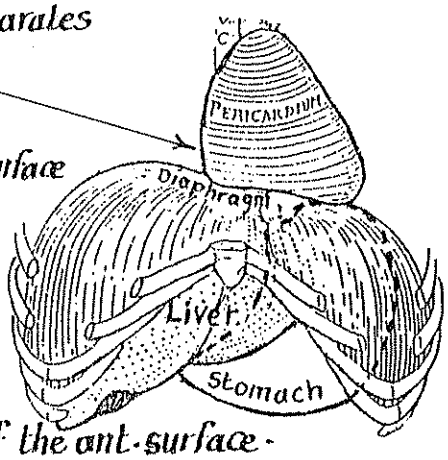
(1) Anterosuperior surface: Completely covered by the peritoneum of the greater sac.

(2) posteroinferior " : Covered by the peritoneum of the lesser sac except a small area close to the cardiac orifice (bare area of the stomach) which is not covered by peritoneum & is related to the Lt. crus of the diaphragm.

Relations of the Stomach

1- The **Fundus**: is related to the diaphragm which separates it from the pericardium & heart

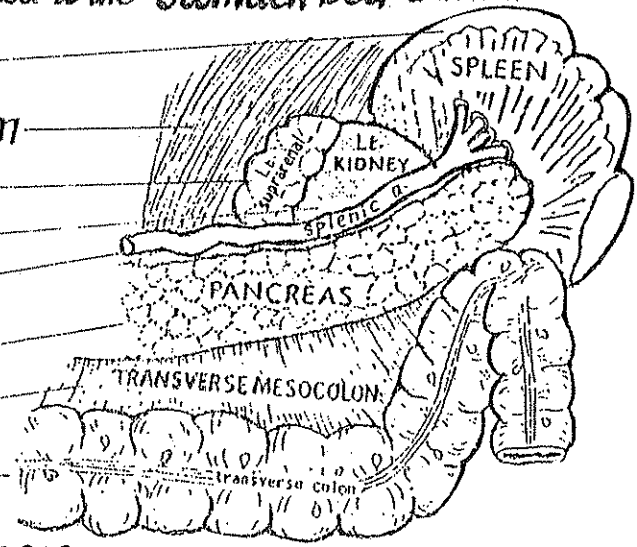
2- The **Antero-superior surface (ant. relations)**:
- (a) diaphragm: related to the upper & Lt. area of ant. surface separating it from the Lt. pleura & lung.
- (b) Lt. costal margin
- (c) Lt. lobe of liver: related to a narrow area adjoining the lesser curvature.
- (d) Ant. abd. wall: related to the lower & Rt. part of the ant. surface.



(3) **The postero-inferior surface**: related to the "Stomach bed" which includes:

4 left-sided structures
- (1) Spleen
- (2) Lt. crus of diaphragm
- (3) Lt. suprarenal gland
- (4) Lt. kidney

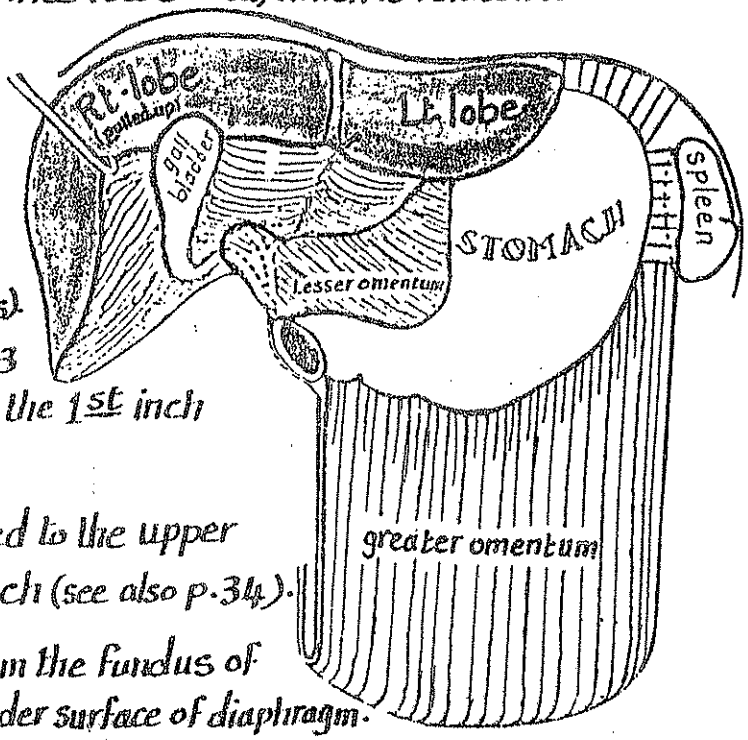
4 transverse structures
- (5) Splenic artery
- (6) body of pancreas
- (7) transverse mesocolon
- (8) transverse colon



N.B: the stomach is separated from the previous structures by the lesser sac.

4) **The Pyloric end:**
- related anteriorly to quadrate lobe of the liver.
- " posteriorly to the neck of pancreas & lesser sac.

5) **Peritoneal relations of the Stomach:**
the stomach is completely covered by peritoneum except a small triangular area on the post. surface close to the cardiac orifice (bare area) which is related to the left crus of the diaphragm.



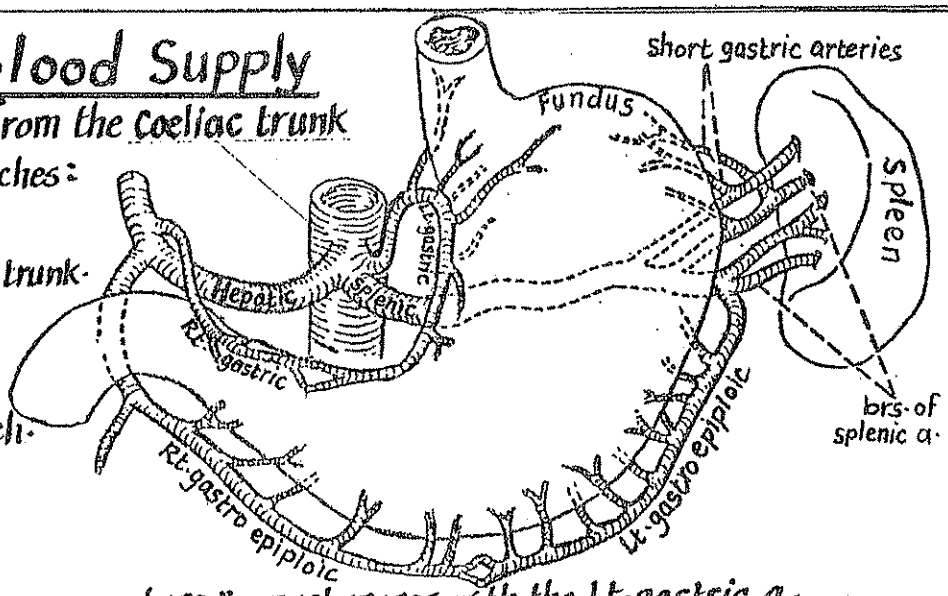
Ligaments of the stomach:

1) Lesser omentum: attached to the lesser curvature of the stomach + the first inch of the duodenum (see p.64 for details).
2) Greater omentum: attached to the Rt. 2/3 of the greater curvature of the stomach + the 1st inch of the duodenum (see p.35 for details).
3) Gastrosplenic lig. or omentum: attached to the upper Lt. 1/3 of greater curvature of the stomach (see also p.34).
4) Gastrophrenic lig.: extends upwards from the fundus of the stomach to the under surface of diaphragm.

Blood Supply

Ant. relations

1) Arterial supply: derived from the coeliac trunk & its branches:



Lt. gastric a.:
arises directly from the coeliac trunk.
runs along the upper part of the lesser curvature
it is the largest a. of the stomach.

Rt. gastric a.:
arises from the hepatic a.
runs along the lower part of lesser curvature & anastomoses with the Lt. gastric a.

Post. relations (Stomach bed)

Lt. gastro epiploic a.:
arises from the splenic a. & runs along the upper part of the greater curvature

Rt. gastro-epiploic a.
arises from the gastroduodenal a. (br. of hepatic a.)
runs along the Rt. part of greater curvature & anastomoses with the Lt. gastro epiploic a.

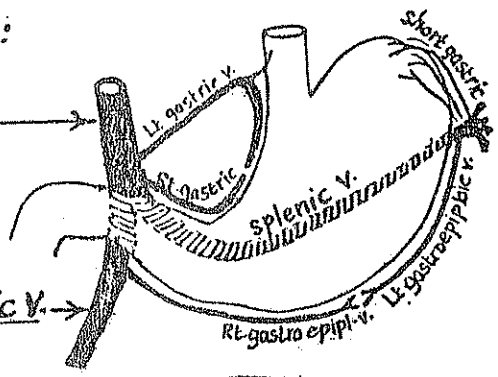
3) Short gastric arteries: arise from splenic a. & pass to the fundus of the stomach.

B- Venous drainage: into portal V. & its tributaries:

(1) Lt. gastric V. } drain into portal V.
(2) Rt. gastric V. }

(3) Lt. gastro epiploic V. } drain into splenic V.
(4) Short gastric VV. }

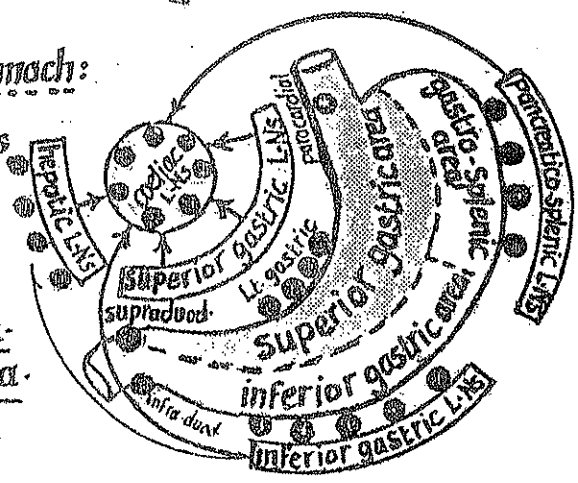
(5) Rt. gastro epiploic V.: drain into sup. mesenteric V.



C- Lymphatic drainage:

(A) Lymphatic territories (areas) of the stomach:

an imaginary line along the longitudinal axis of the stomach divides it into:
- Rt. 2/3 : superior gastric area
- Lt. 1/3 : which is further subdivided into:
  - (a) upper 1/3 : gastro splenic area.
  - (b) lower 2/3 : inferior gastric area.



(B) Lymph nodes draining the stomach:

the draining L-Ns are arranged in chains along the greater & lesser curvatures in relation to the major vessels & include the following groups.

Lymph node groups	area drained by it	efferent lymphatics pass to:
1- Sup. gastric L-Ns which include: (a) paracardiac group around cardiac orifice (b) Lt. gastric group along Lt. gastric a. (c) supra pyloric group above pylorus	Sup. gastric area.	Coeliac L-Ns.
2- Inf. gastric L-Ns: along Rt. gastro epiploic a.	Inf. gastric area.	Coeliac L-Ns, few pass to the hepatic L-Ns.
3- pancreatico-splenic L-Ns: in the gastrosplenic lig.	gastro-splenic area.	Coeliac L-Ns.

* Nerve supply of stomach: autonomic fibres:

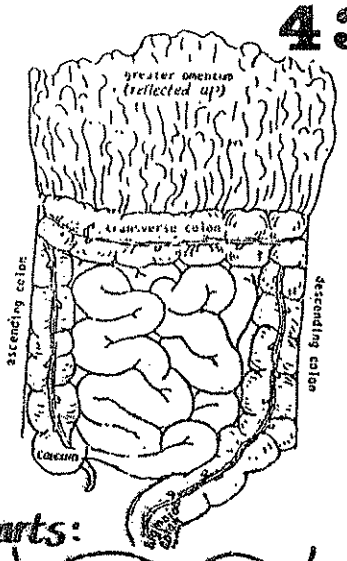
(A) Sympathetic fibres (arise from spinal cord segments from T6 to T10):

- Course: pass with greater splanchnic n. → relay in coeliac ganglion → postgang fibres reach the stomach via gastric & gastro epiploic arteries
- Function: (1) vasomotor (2) motor to pyloric sphincter but inhibitory to the rest of stomach musculature (3) chief pathway for pain sensation from stomach.

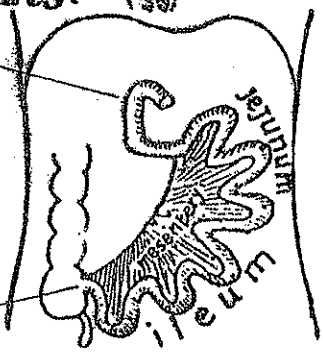
(B) Parasympathetic fibres (arise from both Vagi):

- Course: (1) ant. gastric n. (continuation of Lt. vagus) supplies the ant. surface of the stomach down to the pylorus
  (2) post. gastric n. (continuation of Rt. vagus) " " post. surface of the stomach except the pylorus & gives branches to the coeliac plexus.
- Function: (1) motor to the gastric wall (2) secretory to gastric juice.

Small intestine



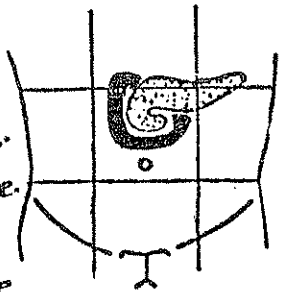
* **Position**: in the infracolic compartment of the greater sac occupying the central & lower parts of the abdomen
* **Relations**: it is surrounded by the curve of the large intestine & covered anteriorly by greater omentum & the ant. abdominal wall.
* **Beginning**: at the pyloroduodenal junction.
* **Termination**: at the ileocaecal junction where it joins the caecum
* **Length & parts**: it is 6 meters (20 feet) long & is formed of 3 parts:



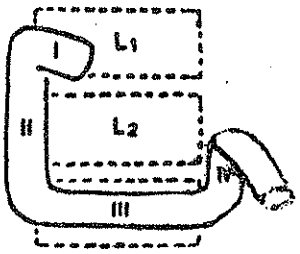
(1) **Duodenum**: the first 10" & is fixed to the post-abdominal wall
(2) **Jejunum**: follows the duodenum. It is 8 feet long & forms the proximal 2/5 of the small intestine.
3) **Ileum**: next to the jejunum. It is 12 feet long & forms the distal 3/5 of small intestine. It ends by joining the caecum at the ileocaecal valve.

N.B: both jejunum & ileum have a mesentery attaching them to the post. abd. wall.

Duodenum

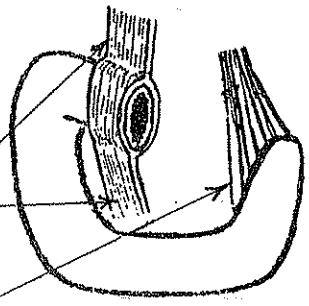


* It is the shortest, widest & most fixed part of the small intestine.
* **Site**: in the epigastric & umbilical regions, above the level of the umbilicus. It is applied to the post-abd-wall against the upper 3 lumbar vertebrae.
* **Shape**: C-shaped loop surrounding the head of pancreas
* **Begins**: at the pyloric end of the stomach ½" to the Rt. of the median plane
* **Ends**: " " duodenojejunal flexure 1" to the Lt. " " " "
* **Length & parts**: it is 10" long & is divided into 4 parts:



(1) 1st (superior) part: 2" long & lies opposite the 1st L. vertebra.
(2) 2nd (descending) " : 3" " & extends from L1 to L3 vertebra.
(3) 3rd (horizontal) " : 4" " & lies at the level of L3 vertebra
(4) 4th (ascending) " : 1" " & ascends from the level of L3 to L2

Peritoneal relations:



the duodenum is mostly retroperitoneal and fixed to the post. abd. wall except the following 2 mobile parts:
(1) the proximal 1" which is suspended by < (i) lesser omentum: above; (2) greater omentum: below
(2) the distal end which is attached to the right crus of diaphragm by a fibromuscular band called the suspensory muscle of duodenum.

FIRST PART OF DUODENUM

* **Begins**: as a continuation of the pylorus, ½" to the Rt. of the median plane at the level of L1 (transpyloric plane).
* **Course**: it passes upwards, backwards & to the Rt. undercover of the quadrate lobe of the liver.
* **Ends**: close to the neck of gall bladder by curving downwards to become the 2nd part.
* **Peritoneal connections**:
  - its 1st inch is completely covered by peritoneum & gives attachment to the lesser omentum above & greater omentum below.
  - its 2nd inch is covered by peritoneum only infront & above.

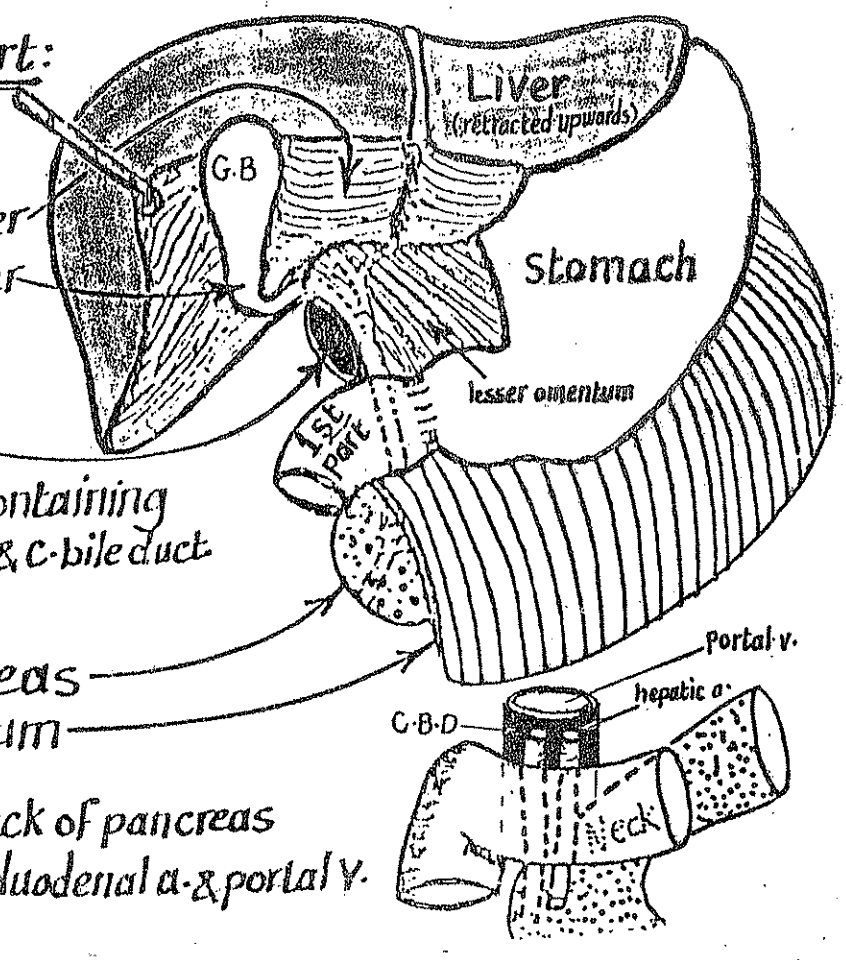
* **Relations of the 1st part**:

I-Anteriorly:
(1) quadrate lobe of liver
(2) neck of gall bladder

II-Superiorly:
(1) epiploic foramen
(2) lesser omentum containing portal V., hepatic a. & C.bile duct

III-Inferiorly:
(1) head of pancreas
(2) greater omentum

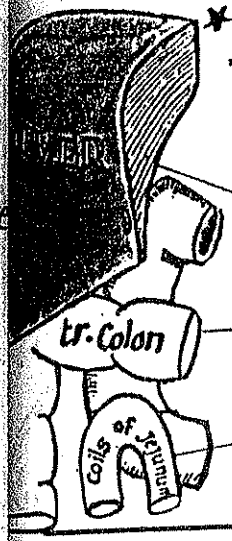
IV-posteriorly: (1) neck of pancreas
(2) C-B-duct, gastroduodenal a. & portal V.



SECOND PART OF DUODENUM

* **Begins**: at the level of L1 as a continuation of the 1st part.
* **Course**: it descends vertically downwards infront of the hilum of the Rt. kidney.
* **Ends**: at the level of L3 by curving to the left to become the 3rd part.
* **Peritoneum**: it is covered by peritoneum only anteriorly except its middle part which is devoid of peritoneum & is directly related to the transverse colo

* Relations of 2nd part of duodenum: (3 structures on each side):

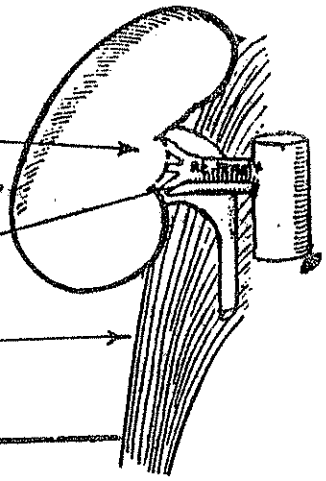


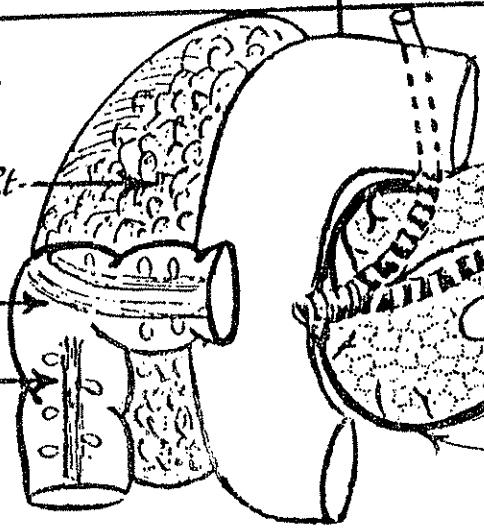
(A) Anteriorly:

(1) Rt. lobe of the liver (in the upper part).
(2) transverse colon (in the middle part).
(3) Coils of jejunum (in the lower part).

(B) Posteriorly:

(1) the hilum of Rt. kidney & adjoining part of ant surface.
(2) Rt. renal vessels
(3) Rt. psoas major m.





(C) Laterally:

(1) fat infront of the Rt. kidney.
(2) Rt. Colic flexure
(3) Ascending colon

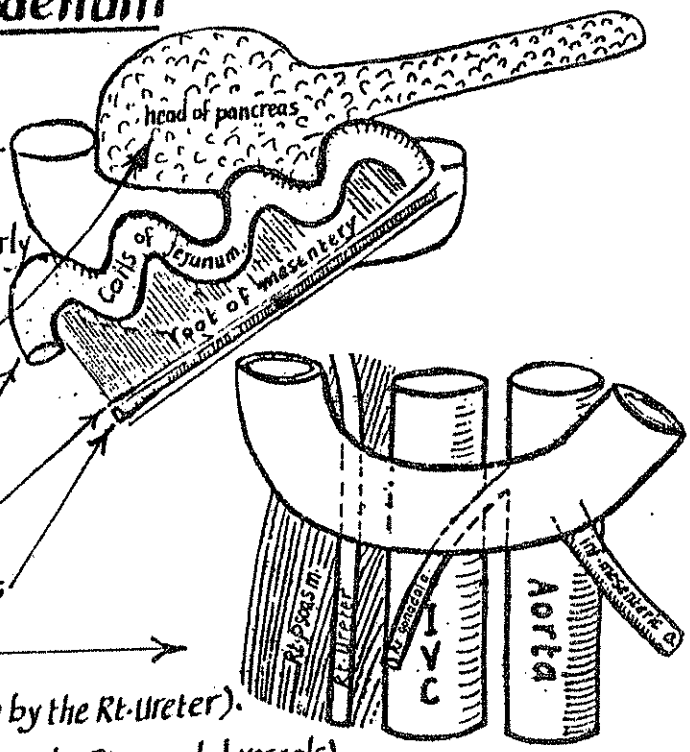
(D) Medially:

(1) head of pancreas.
(2) ampulla of Vater (hepato-pancreatic ampulla) opens in the posteromed aspect of 2nd part of duod. just below its middle.
(3) sup. & inf. pancreatico-duodenal vessels in the groove between head of pancreas & 2nd part of duodenum

3rd Part of duodenum

* **Length**: it is the longest part (4" long).
* **Course**: it passes horizontally from Rt. to Lt. at the level of L3 vertebra.
* **peritoneum**: it is covered by peritoneum anteriorly and inferiory.
* **Relations**:

A- superiorly: head of pancreas
B- inferiorly: coils of jejunum.
C- Anteriorly: (1) coils of jejunum (2) root of mesentery (3) sup. mesenteric vessels
D- Posteriorly (from right to left):



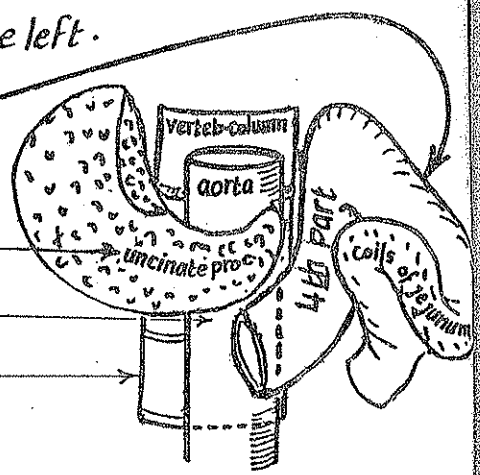
(1) Rt. psoas major m. (separated from duodenum by the Rt. ureter).
(2) inferior vena cava: (" " " " the Rt. gonadal vessels).
(3) abdominal aorta: (" " " " the inf. mesenteric artery).

4th part of duodenum

* **Length**: it is the shortest part of the duodenum (one inch long).
* **Course**: it ascends along the Lt. side of the vertebral column (from L3 to L2).
* **peritoneum**: it is covered by peritoneum anteriorly & to the left.
* **Relations**:

(a) anterolaterally: Coils of jejunum.

(b) medially (to the Rt.): (1) uncinate process of pancreas
(2) abdominal aorta
(3) vertebral column

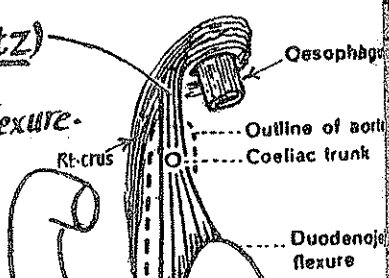


(c) posterior relations:

(1) med. border of Lt. psoas major m.
(2) Lt. renal vessels
(3) Lt. sympathetic chain
(4) Lt. gonadal vessels

* **Termination**: it ends by curving forwards to form the duodeno-jejunal flexure on the Lt. side of L2

Suspensory muscle of duodenum (Lig. of Treitz)



* it is a fibromuscular band which suspends the duodenojejunal flexure.
* it arises from the Rt. crus of diaphragm close to the œsophagus
* it descends behind the pancreas to be attached to the post. aspect of the duodenojejunal flexure & the 3rd & 4th parts of duod.
* it contains striated & smooth muscle fibres & also elastic fibres

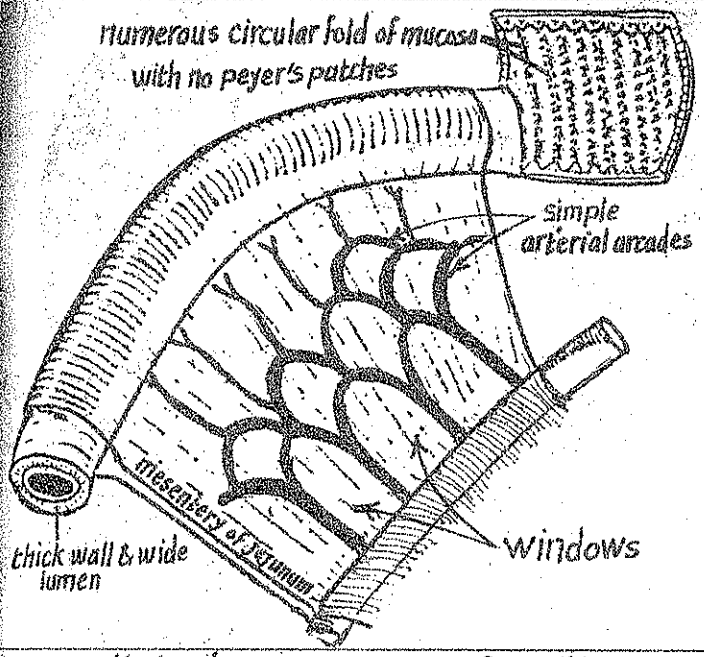
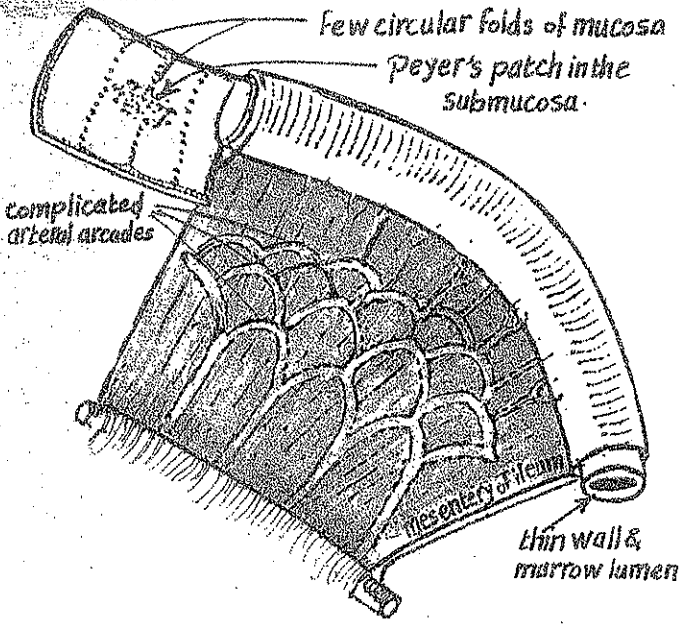
* **Arterial supply of duodenum**:

(1) sup. pancreaticoduodenal a. (br. of gastroduodenal a.)
(2) inf. " " " (br. of sup. mesenteric a.)
} both arteries run in the curved groove between the duod. & head of pancreas & anastomose together.

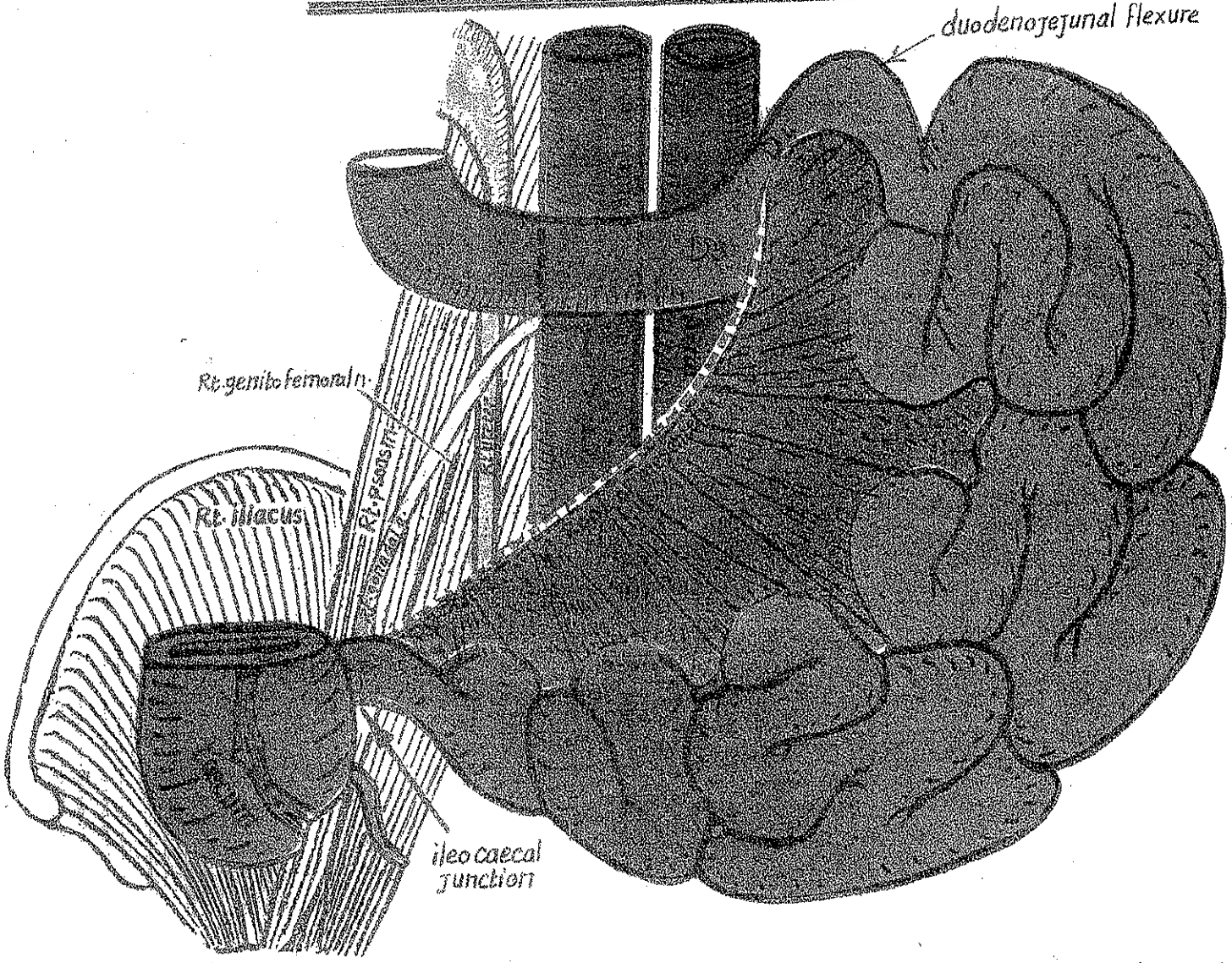
(3) Branches from hepatic, Rt. gastric, Rt. gastroepiploic & supraduodenal arteries.

* **Venous drainage**: into splenic, sup. mesenteric & portal veins.
* **Lymphatic drainage**: into pyloric, sup. mesenteric & hepatic lymph nodes.
* **Nerve supply**: sympathetic nerves from T9 & T10 and the parasymp. nerves from vagi pass through the cœliac plexus & accompany the arteries to the duodenum.

The Jejunum & Ileum

Jejunum	Ileum
	
* Constitute the proximal 2/5 of small intestine.	Constitutes the distal 3/5 of small intestine.
* about 8 feet long.	* about 12 feet long.
* Site: tends to lie more in the umbilical region	* tends to lie more in the hypogastrium.
* Lumen: wider than ileum.	* narrower than jejunum.
* Wall: thicker, having thicker mucosa (due to active absorption) & thicker musculosa (due to active peristalsis).	* thin wall (having thinner mucosa and musculosa) because digestion & absorption are less active in the ileum than jejunum.
* Circular folds of the mucosa are more numerous.	* the mucosa contains few circular folds.
* Peyer's patches (aggregation of lymphoid follicles in the submucosa): are absent	* many Peyer's patches in the submucosa along the antimesenteric border of ileum.
* the jejunal arteries anastomose together forming one or 2 arches (simple arterial arcades) in the mesentery of the jejunum.	* the ileal arteries form 3 or 4 or even 5 arches in the mesentery of ileum (complicated arterial arcades).
* the jejunal mesentery contains less fat allowing light to pass in the spaces between arteries (windows of mesentery).	* the mesentery of ileum contains dense fat which masks the arteries (no windows).
* At operation the jejunal wall is felt as double layer	* At operation the ileal wall is felt as single layer.

Mesentery of the Small intestine



* **Definition**: it is a peritoneal fold enclosing the free part of the small intestine (jejunum & ileum) & connecting it to the post. abdominal wall.

* **Shape** : Fan-shaped fold having broad free border & narrow attached border

(a) the free border: is 6 meters (20 feet) long & encloses the jejunum & ileum.

(b) attached border: (Root of mesentery): 6" long & 6" away from the free border (de

- it is attached to the post. abdominal wall extending from the duodenojejunal flex (on the Lt. side of L2) to the ileocaecal junction (above the Rt. sacroiliac joint).
- its attachment follow a curved course with its concavity directed to the Rt. side.
- the root **crosses 6 structures** on the post. abd. wall (2 parts of duodenum, 2 large vessels & 2 muscles):

(1) the 4th part of duodenum. (2) the 3rd part of duodenum.

(3) the abdominal aorta. (4) the inferior vena cava (I.V.C).

(4) the Rt. psoas major m. with structures on it: (Rt. ureter, Rt. gonadal vessels & Rt. genitofemoral n.).

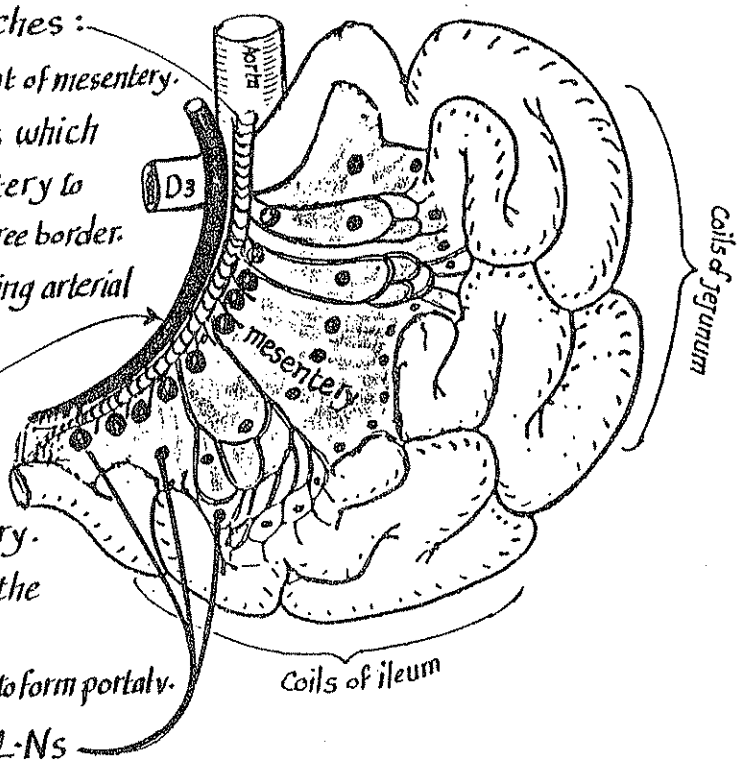
(5) the Rt. iliacus m.

Contents of the mesentery:

1) Coils of jejunum & ileum in the free margin of the mesentery.

2) superior mesenteric a. & its branches:
- it runs downwards & to the Rt. in the root of mesentery.
- it gives 12-16 jejunal & ileal branches which run between the 2 layers of the mesentery to reach the coils of small intestine in the free border.
- its branches anastomose together forming arterial arches (arcades).

(3) Sup. mesenteric v. & its tributaries:
- runs in the root of mesentery on the Rt. side of the sup. mesenteric artery.
- receives tributaries corresponding to the branches of the sup. mesenteric a.
- it ends by joining the **splenic vein** to form portal v.



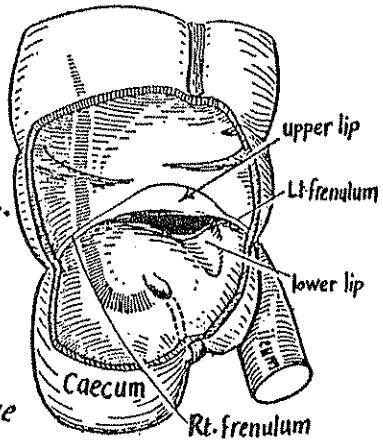
(4) Lympatics & 3 raws of mesenteric L.Ns
- (a) small lymph nodes near the intestine in the free border.
- (b) medium-sized L.N in the middle of the mesentery
- (c) large L.Ns: lie along the sup. mesenteric vessels

these nodes are connected by lymph vessels called lacteals (carry white milk-like lymph loaded with absorbed fat called chyle from the small intestine).

(5) dense plexuses of autonomic nerve fibres around the arteries.

(6) Extraperitoneal fatty tissue.

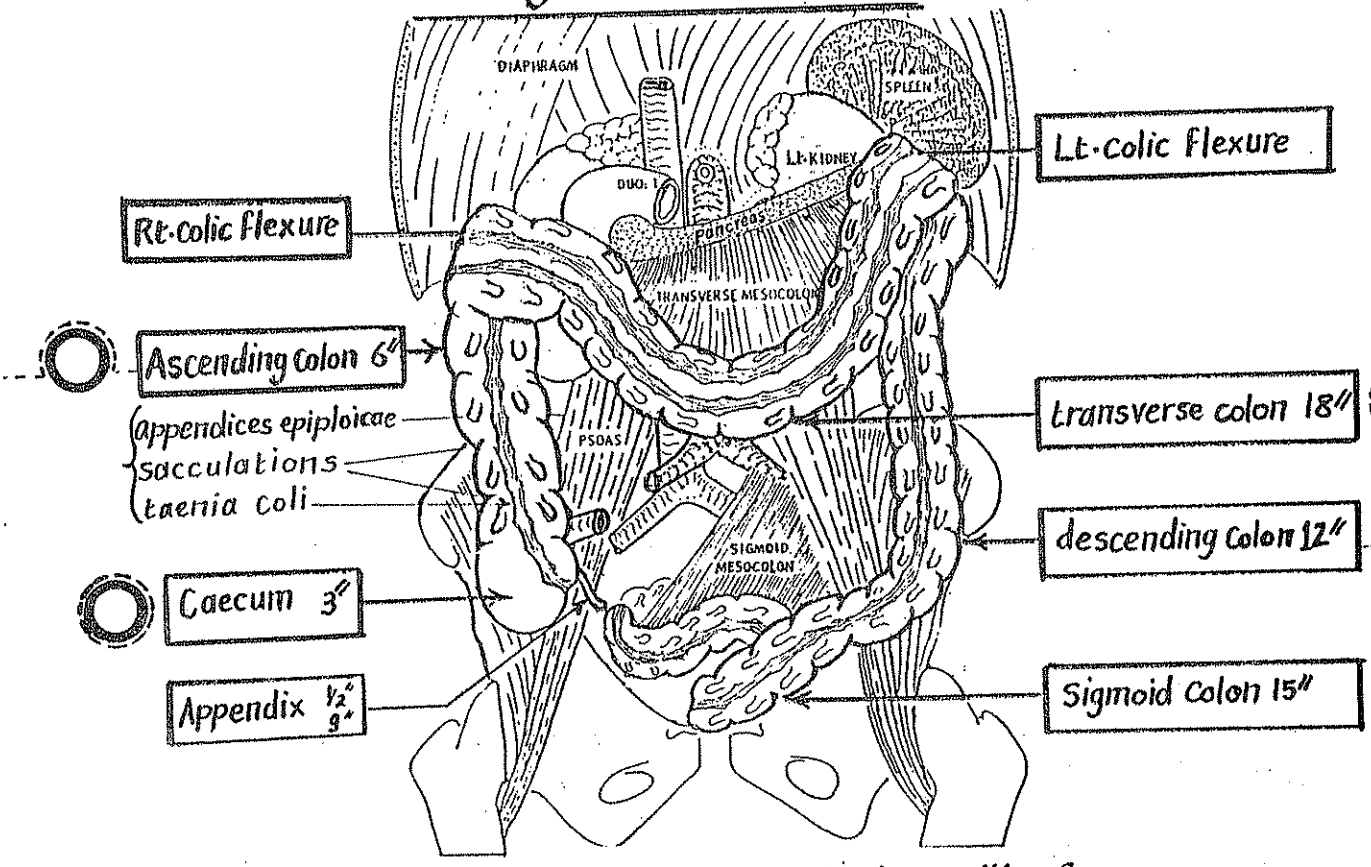
Ileocaecal Valve



* It is the valve which guards the opening of the ileum into the caecum.
* site & surface anatomy: it lies in Rt. iliac fossa at the point of junction between the Rt. lat. vertical plane & the intertubercular plane.
* **Structure**: it has 2 lips (upper & lower) & 2 frenula (Rt. & Lt.):
  - (a) upper lip: horizontal & lies at the ileo colic junction.
  - (b) lower lip: concave & longer, lying at the ileo caecal junction.

  the Rt. & Lt. frenula are formed by fusion of the lips at the ends of the apearture.
* **Function**: it regulates the passage of ileal contents into the caecum & prevents reflux from caecum to ileum.
* **Mechanism**: it closes actively by symp. stimulation & passively by distension of the caecum.

Large Intestine



* **Beginning**: it begins at the ileocaecal valve in the Rt. iliac fossa.
* **Termination**: at the anal orifice.
* **Length**: 5 feet (1.5 meters) long.
* **parts**: (1) Caecum & appendix (2) ascending colon (3) Rt. Colic (hepatic) flexure (4) transverse colon (5) Lt. colic (splenic) flexure (6) descending colon. (7) pelvic (sigmoid) colon (8) Rectum & anal canal.

* Differences between the large & small intestine:

the large intestine is charecterized by the following 3 features:

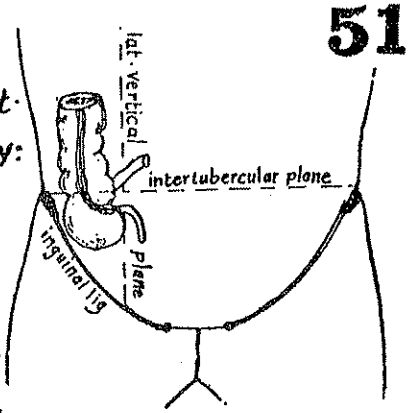
(1) **Appendices epiploicae**: are small peritoneal sacs filled with fat scattered over the surface of large intestine (except appendix, caecum & rectum).

(2) **Taenia coli**: the longitudinal muscle fibres of the large intestine are grouped into 3 longitudinal bands starting at the base of the appendix. They are arranged as one ant. & 2 post. bands in both ascending & descending colon. In the transverse colon they are 2 ant. & one post. In the appendix & rectum they are absent.

(3) **Sacculations (haustrations)**: the length of the taenia coli is shorter than the the true length of the large intestine causing puckering of its wall.

N.B: the previous 3 characters are **absent in the small intestine**.

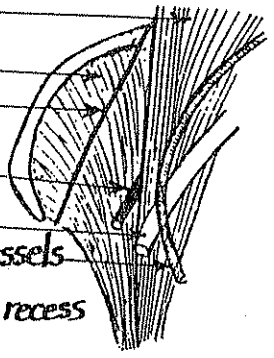
Caecum



* **Site:** in the Rt. iliac fossa above the lat. ½ of the inguinal ligament.
* **Surface anatomy:** a triangular area in the Rt. iliac fossa bounded by:
  (1) intertubercular plane : above
  (2) lat. ½ of the inguinal lig. : below
  (3) Rt. lateral vertical plane : medially
* **Shape & size:** a blind pouch 3" long (closed below & open above).
* **Communications:** (1) above: it is continuous with ascending colon.
  (2) medially: " communicates with terminal part of ileum via ileocaecal valve.
  (3) posteromedially: the appendix opens into it about 1" below " "
* **Peritoneal Covering:** it is usually completely covered with peritoneum (thus it is a mobile organ) & is related to 3 peritoneal recesses (see page 37).

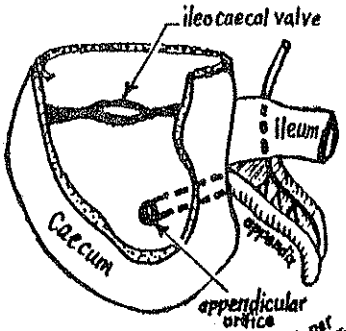
Relations

I- Anteriorly:
- (1) ant. abdominal wall
- (2) lower part of greater omentum
- (3) coils of small intestine

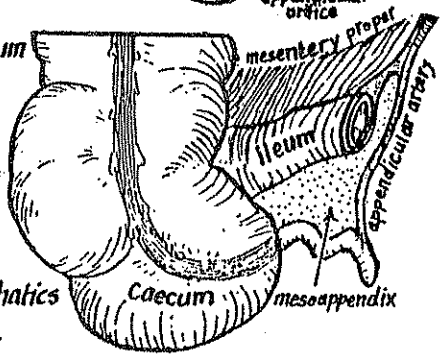


II- Posteriorly:
- 2 muscles: (1) Rt. psoas major muscle; (2) Rt. iliacus muscle
- 2 nerves: (3) Rt. lat. cutaneous n. of thigh; (4) Rt. femoral nerve
- 2 Vessels: (5) Rt. external iliac vessels; (6) Rt. gonadal (testicular or ovarian) vessels
- (7) Vermiform appendix in the retrocaecal recess (in 65% of people).

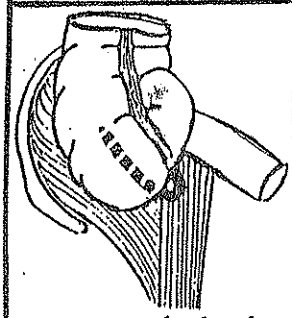
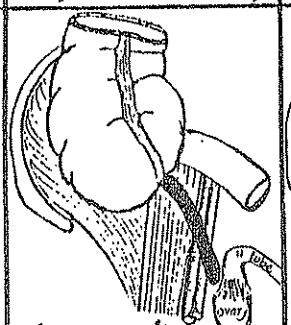
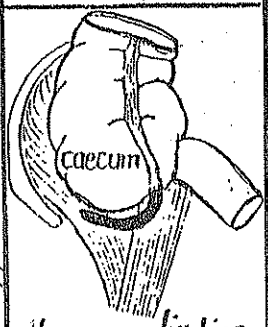
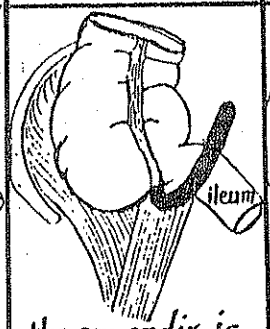
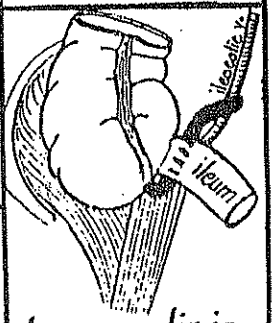
Appendix



* **Site:** in the Rt. iliac fossa, attached to the posteromedial aspect of caecum one inch below the ileocaecal valve.
* **Size:** ½ – 9" (average 4" long). It is the narrowest part of gut.
* **Shape:** worm-like tube, closed distally but open proximally into the caecum.
* **Peritoneal Covering:** usually completely covered by peritoneum & suspended by a peritoneal fold called Mesoappendix.
* **the Mesoappendix:** is a small triangular peritoneal fold which suspends the appendix from the post. surface of the lower end of the mesentery of the small intestine.
  It **Contains:** (1) appendicular vessels (at the free margin) (2) lymphatics & L.Ns. (3) autonomic n. fibres (4) extraperitoneal fatty tissue.

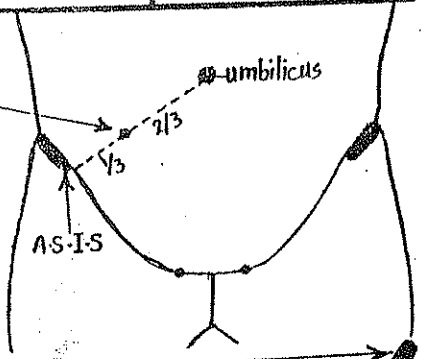


*Positions of the appendix:

1-Retrocaecal (65%)	2-pelvic (31%)	3-Subcaecal (2%)	4-pre-ileal (1½%)	(5) post-ileal (½%)
				
the appendix lies in the retrocaecal recess in contact with iliopsoas muscle. (commonest position)	the appendix hangs over the pelvic brim coming in relation with Rt. obturator n., ureter, ovary & uterine tube	the appendix lies just below the caecum	the appendix is directed upwards infront of terminal part of ileum	the appendix is directed upwards behind the terminal part of ileum (related to ileocolic vein).

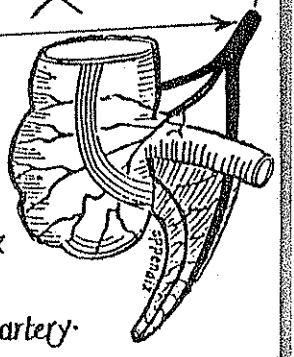
*Surface anatomy: Mc Burney's point:

- the base of the appendix lies opposite a point at the junction of the lateral ⅓ & medial 2/3 of a line joining the Rt. ant. sup. iliac spine with the umbilicus.



*Arterial Supply: appendicular artery:

- it is a branch of the ileocolic artery
- it descends behind the terminal part of ileum to enter the free border of the mesoappendix till it reaches the apex of the appendix
- it is accompanied by appendicular V. which drains into sup. mesenteric V.



*Lymphatic drainage:

numerous lymphatics drain into
(1) appendicular L.Ns (1-2) in the mesoappendix
(2) iliocolic L.Ns alongside ileocolic artery.
(3) mesenteric L.Ns. alongside sup. mesenteric artery.

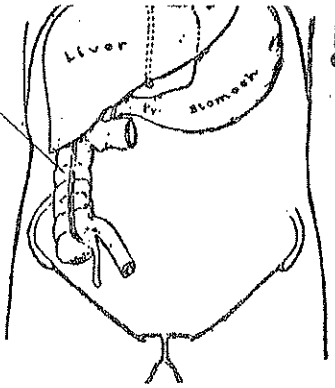
*Nerve Supply:

- Sympathetic: from T10 segment via the sup. mesenteric plexus.
- parasympathetic: from the Vagus n.

*Applied anatomy:

(1) inflammation of appendix (appendicitis) is common because:
  (a) it is the narrowest part of the gut & has a blind end thus liable to obstruction.
  (b) its submucosa is rich in lymphoid tissue (thus liable to infection).
(2) necrosis & rupture of the inflamed appendix is common because it has a single artery (appendicular a.) which may become thrombosed by the inflammation.
(3) pain of the inflammed appendix is referred to the umbilicus because both are supplied by T10.
(4) the 3 taenia coli of the caecum converge towards the base of appendix (a landmark for identification of the appendix at surgical operations).

Ascending colon



*Site: in the Rt. lumbar region (extending from the ileocaecal valve to the Rt. colic flexure).

*Size: about 6" (15 cm) long.

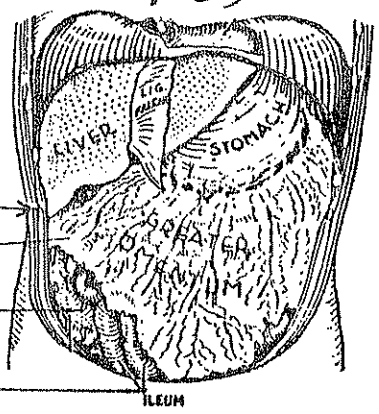
*Taenia coli: one anterior & 2 posterior.

*Peritoneum: Covers the front & sides only and forming the Rt. medial & Rt. lateral paracolic gutters (see p. 31)

* Relations

I- Anteriorly & laterally:

(1) anterior abdominal wall
(2) Rt. border of greater omentum
(3) coils of ileum.

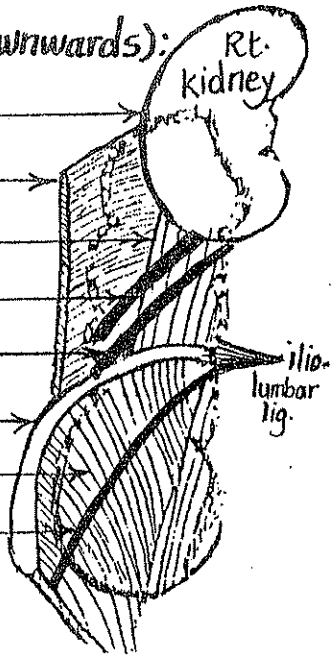


II- Medially: coils of ileum

III Posteriorly: it lies the following structures (from above downwards):

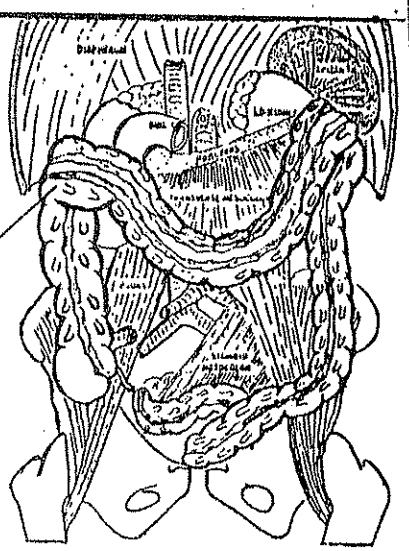
(1) lower lateral part of Rt. kidney
(2) origin of transversus abdominis muscle
(3) quadratus lumborum muscle
& related nerves: iliohypogastric, ilioinguinal
(4) iliac crest & iliolumbar ligament
(5) iliacus muscle
(6) lateral cutaneoun n. of thigh

(of the Rt. side)



*Arterial Supply: Rt. colic a. & ascending br. of ileocolic a.

Transverse colon



Site: it extends transversely between the Rt. & Lt. colic flexures being convex downwards reaching the umbilical region.

Begins: in the Rt. hypochondrium, following the Rt. colic flexure

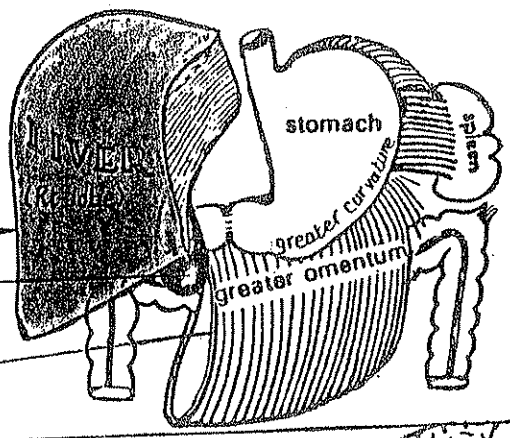
Ends: » » Lt. hypochondrium by becoming the Lt. colic flexure

Size: 18-20 inches long.

Taenia coli: 2 anterior & one posterior.

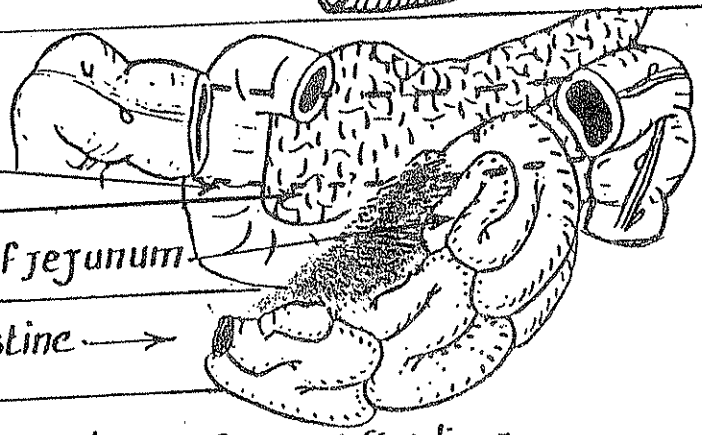
Peritoneum: it is completely covered with peritoneum except the Rt. 2" where it is adherent to the 2nd part of duodenum & head of pancreas. It has a transverse mesocolon (see p. 35).

Relations of transverse colon



I- Antero-superiorly : (From right to left) :

(1) Right lobe of liver
(2) gall bladder
(3) greater curvature of stomach
(4) greater omentum



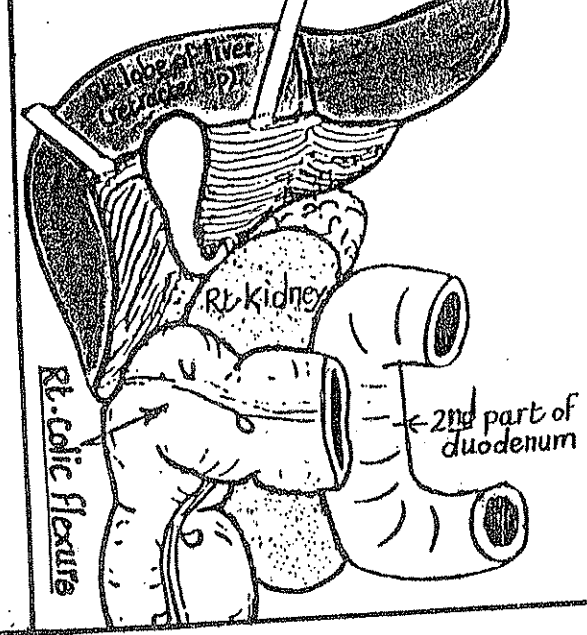
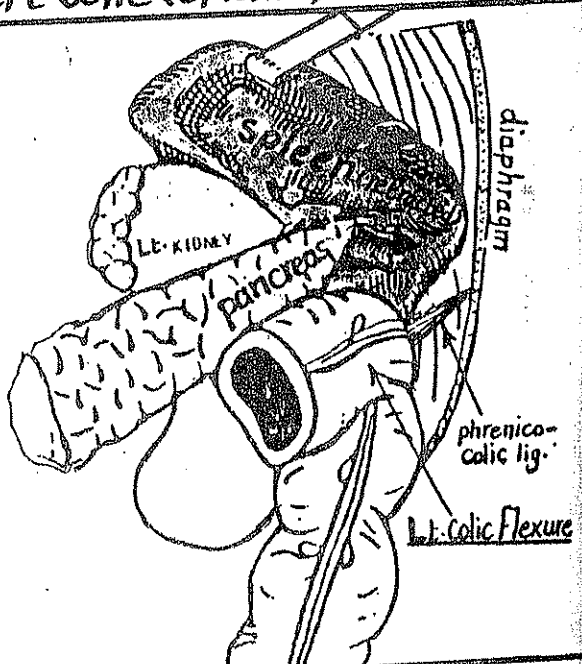
II- Posteriorly : (From right to left) :

(1) second part of duodenum
(2) head of pancreas
(3) duodenojejunal flexure & coils of jejunum

III- Inferiorly : Coils of small intestine

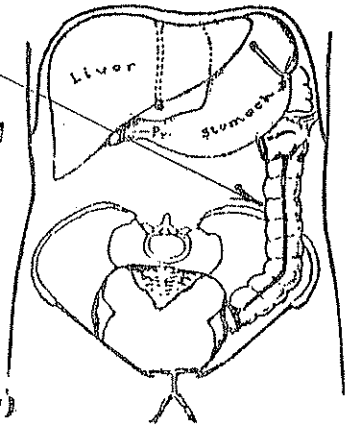
* **Arterial Supply** : middle colic a. & ascending br. of upper left colic a.

Colic flexures

	Right Colic (Hepatic) Flexure	Left Colic (Splenic) Flexure
		
Position	- in the Rt. hypochondrium just below the Rt. lobe of liver. - lies at a lower level (L2), more closer to middle line & more superficial.	- in the Lt. hypochondrium, in contact with lat. end of spleen. - lies at a higher level (L1), more distant from middle line & more deep.
Shape	a blunt flexure forming right angle	a sharp flexure forming acute angle
attachment to diaphragm	not attached to the diaphragm	attached to the diaphragm via phrenico-colic lig.

	Right Colic (hepatic) flexure	Left Colic (Splenic) flexure
Relations	(1) antero-superiorly : right lobe of liver (colic impression). (2) postero-inferiorly : right kidney (3) medially : 2nd part of duodenum	(1) antero-superiorly : Spleen & tail of pancreas. (2) postero-inferiorly : left kidney & diaphragm (3) medially : Lt. kidney.
Arterial supply	Rt. Colic a.	Lt. Colic a.

Descending colon



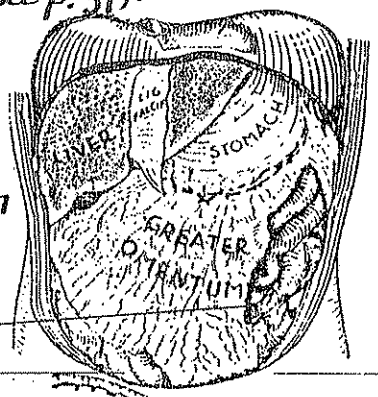
Site: in the Lt. lumbar & Lt. iliac regions, descending from the Lt. Colic flexure above to the Lt. border of pelvic brim below where it ends by becoming the sigmoid (pelvic) colon

Size: 10-12" long (about double the length of ascending colon but having a narrower lumen).

Taenia Coli : one anterior & 2 posterior (like ascending colon)

Peritoneum : Covers the front & sides only (like ascending colon) & forming the Lt. medial & Lt. lateral paracolic gutters (see p. 31).

Relations

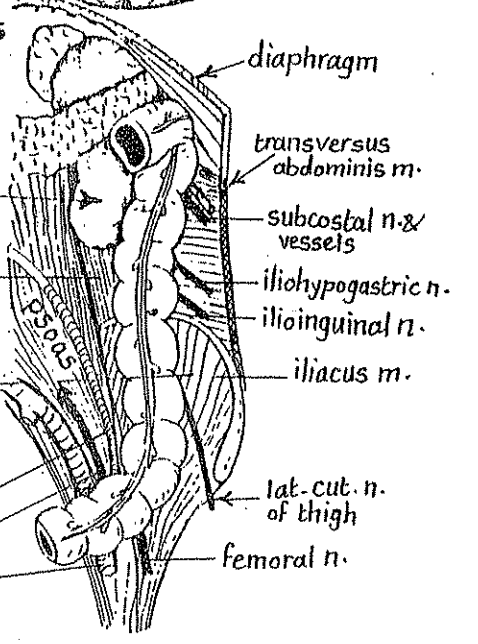


Anteriorly & laterally: (1) anterior abdominal wall
(2) Lt. border of greater omentum
(3) Coils of small intestine

Medial relations: Coils of small intestine

posterior relations: it descends on the following structures

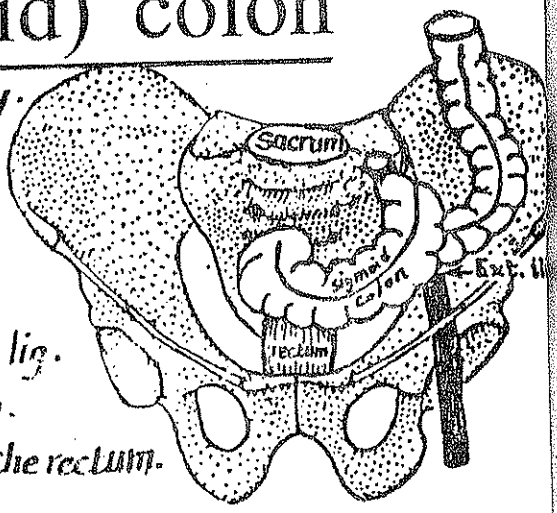
(1) diaphragm
(2) lower lat. part of left kidney
(3) Origin of Lt. transversus abdominis m.
(4) Lt. quadratus lumborum m. & structures infront of it:
(a) subcostal n. & vessels (b) iliohypogastric n. (c) ilioinguinal n.
(5) Lt. iliacus muscle & the structures infront of it :
(a) Lat. cutaneous n. of thigh (b) femoral n.
(6) Lt. Psoas major muscle & structures infront of it : (a) Lt. gonadal vessels (b) Lt. genitofemoral n (c) Lt. external iliac a.



N.B: a) the ant. relations of the descending colon are like those of the ascending colon
b) " post. " " " " " " " " " " " " "
but more extensive above & below.

*Arterial Supply: upper & lower left colic arteries.

pelvic (sigmoid) colon



*Site: in the Lt. iliac fossa & in the pelvic cavity.
*Shape: S-shaped.
*Size: about 16 inches long.
*Begins: infront of external iliac a. at the left border of pelvic brim 2" above the inguinal lig. as a continuation of the descending colon.
*Ends: opposite the 3rd sacral piece by becoming the rectum.

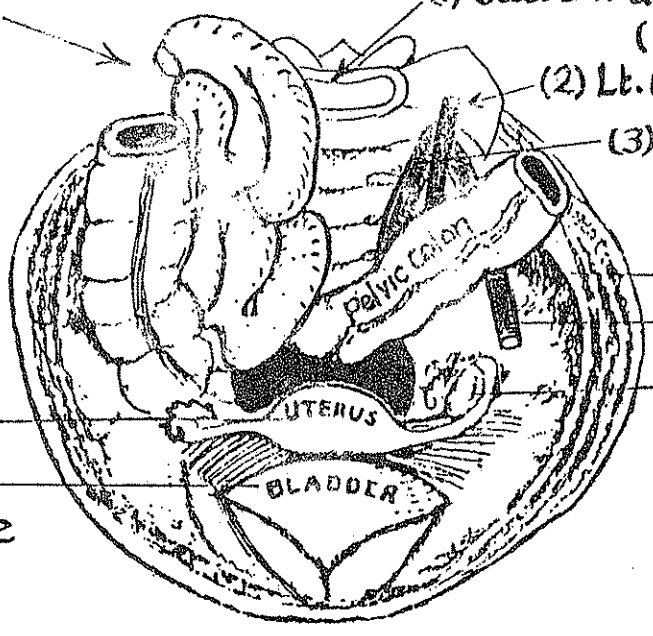
* Relations

I-Superiorly & to the right:
Coils of ileum

II-Posteriorly:
(1) Sacrum & structures infront of it (piriformis & sacral plexus)
(2) Lt. ureter
(3) Lt. internal iliac vessels

III-Inferiorly:
differs according to the sex:
(1) uterus in the female
(2) urinary bladder in both male & female

IV- on the left side
(1) lat. wall of pelvis
(2) Lt. external iliac vess
(3) ovary in the female & vas deferens in the ma

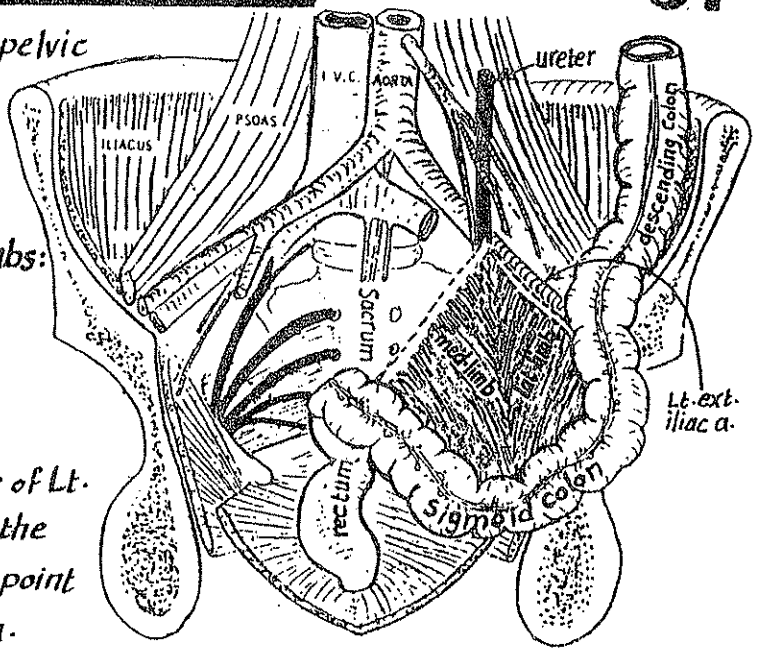


T.S

*Blood Supply: Lower left colic (sigmoid) arteries.

*Peritoneal Covering: the pelvic colon is completely covered by peritoneum & has a mesentery called pelvic mesocolon connecting it to the posterior abdominal wall (see page 57).

Pelvic (sigmoid) mesocolon



* It is a peritoneal fold attaching the pelvic colon to the upper part of the post. wall of the pelvis.

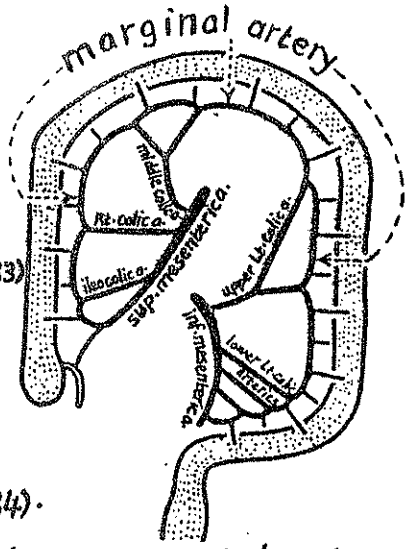
* **Shape:** inverted V-shaped having 2 limbs:
  (a) lat. limb (ascending).
  (b) med. limb (descending).

* **Attachments:**
  (a) lat. limb: attached to the med. side of Lt. ext. iliac along line starting 2" above the inguinal lig. & ascending upwards to the point of bifurcation of the Lt. Common iliac a.
  (b) med. limb: attached to the front of sacrum till the 3rd sacral piece.
  (c) the apex of the inverted V. is attached infront of the Lt. ureter.

* **Contents of the pelvic mesocolon:**

(1) sigmoid (pelvic) colon in the free margin. (2) sigmoid (lower Lt. colic) a.a. in the med. limb.
(3) sup. rectal vessels in the med. limb. (4) sympathetic fibres (around the arteries).
(4) extraperitoneal fatty tissue.

Blood Supply of the Colon



(1) The Caecum, ascending colon & Rt. 2/3 of transverse colon:
are supplied by the sup. mesenteric a. through its ileocolic, Rt. colic & middle colic branches (see page 80).
- venous drainage by corresponding veins draining into sup. mesent. V. (p. 83)

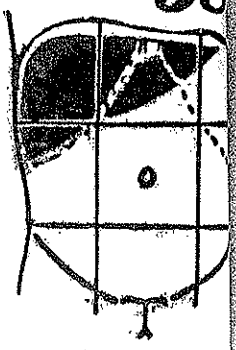
(2) Lt. 1/3 of tr. colon, descending colon & sigmoid (pelvic) colon:
are supplied by the inf. mesenteric a. through its upper Lt. colic & lower Lt. colic (sigmoid) branches (see page 81).
- the corresponding veins drain into the inf. mesenteric V. (page 84).

N.B: the marginal artery: is an arterial arcade lying along the concavity of the colon. It is formed by anastomosis of ileocolic, Rt. colic, middle colic, upper Lt. colic & sigmoid aa. Straight branches called vasa recta arise from the marginal a. to supply the colon.

---

* **Lymphatic drainage of the colon:** the lymphatics of the colon pass through 4 groups of L.Ns: (1) epicolic L.Ns: on the wall of the colon (2) paracolic L.Ns: along inner border of colon. (3) intermediate L.Ns along the colic arteries (4) terminal L.Ns along the trunks of the sup. & inf. mesenteric arteries (are continuous with the preaortic L.Ns).

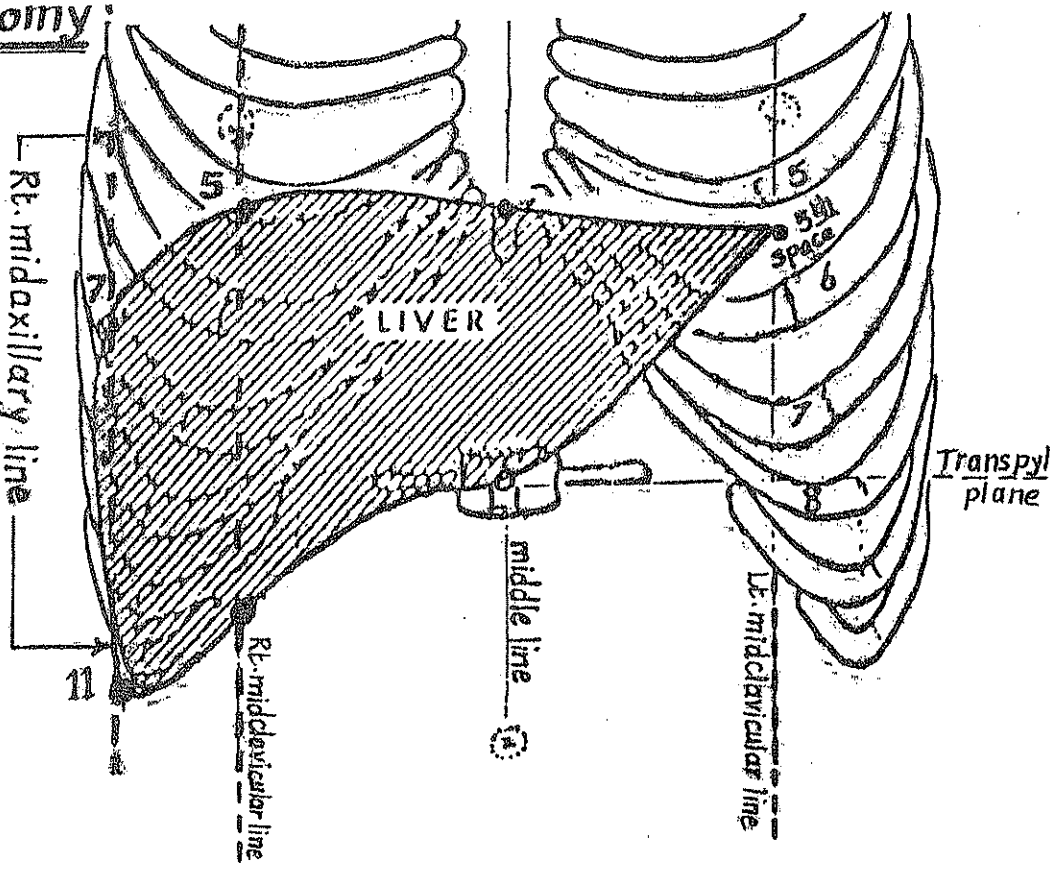
Liver



*Site: in the upper part of the abdominal cavity occupying the Rt. hypochondrium, epigastrium & extending to the left hypochondrium.

*Size: it is the largest organ in the body. It is 1/50 of body weight of the adult (about 1.5 kg).

*Surface anatomy:



The Upper border: represented by a line joining the following points:

(1) a point on the Lt. 5th intercostal space at the Lt. lat. vertical plane.
(2) a point at the xiphisternal junction.
(3) a point on the Rt. 5th rib on the Rt. lat. vertical plane.
(4) a point on the Rt. 7th rib in the midaxillary line.

The lower border: is marked by joining the following points:

(1) point on the Lt. 5th intercostal space in the Lt. lat. vertical plane.
(2) point on the Lt. costal margin at the tip of the Lt 8th costal cartilage.
(3) point at the transpyloric plane in the middle line.
(4) points 1 cm. below costal margin in the Rt. lat. vertical & Rt. midaxillary line.

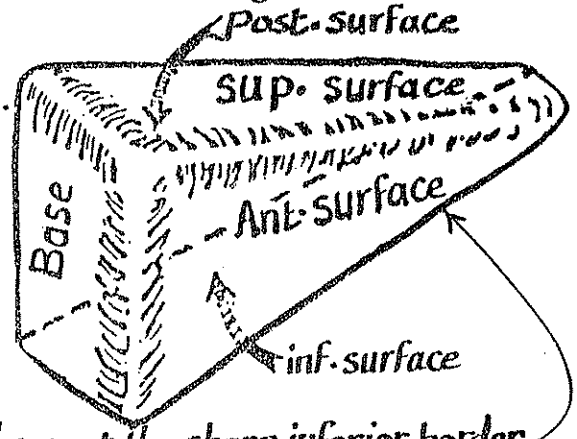
The right border: represented by a line slightly convex to the right joining 2 points:

(1) a point on the Rt. 7th rib at the midaxillary line.
(2) a point on the Rt. 11th rib " " " " " .

*Shape: it is wedge-shaped with its base directed to the right.

*Surfaces: it has 5 surfaces:

(1) Rt. lat. surface (base): quadrilateral.
(2) Superior surface : oblong.
(3) anterior surface : triangular.
(4) inferior surface : irregular.
(5) Posterior surface : irregular.



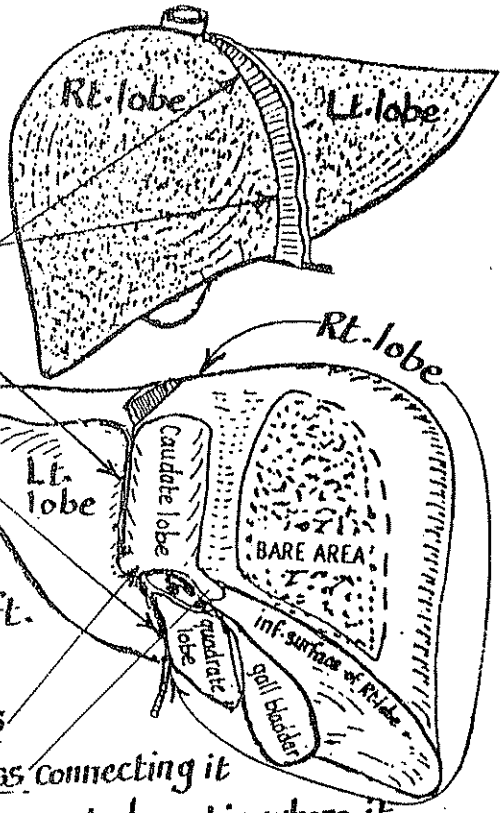
*Borders:

the borders between the surfaces are ill-defined except the sharp inferior border which separates the ant. surface & the base from the inf. surface.

* Lobes of the liver

(A) Anatomical lobes: morphologically, the liver is divided into large Rt. lobe & small Lt. lobe by:

(1) the attachment of falciform lig. on the ant. & sup. surfaces
(2) the fissure for ligamentum venosum on the post. surface
(3) the fissure for ligamentum teres on the inf. surface



N.B: the Rt. anatomical lobe shows 2 smaller lobes:

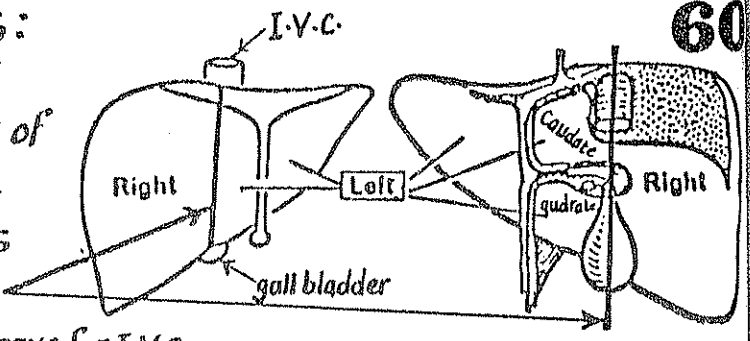
I- Caudate lobe: is the part on the post. surface lying between: (a) groove for the I.V.C: to the right.
(b) fissure for ligamentum venosum: to the left.
(C) porta hepatis : below.

- the caudate lobe has 2 processes: (a) papillary process
(b) Caudate process connecting it with the rest of the Rt. lobe. forming the post. lip of the porta hepatis where it separates the portal vein from the I.V.C. It also forms the upper boundary of epiploic f.

II- quadrate lobe: is the part on the inf. surface lying between:
(a) fossa for gall bladder: to the right.
(b) fissure for ligamentum teres : to the left.
(c) porta hepatis : above.
(d) inf. border of the liver : below.

N.B: both caudate & quadrate lobe belong morphologically to the Rt. lobe but structurally they are parts of the left lobe (see page 60).

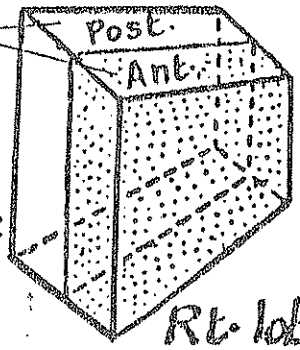
B-Surgical (Structural) lobes:

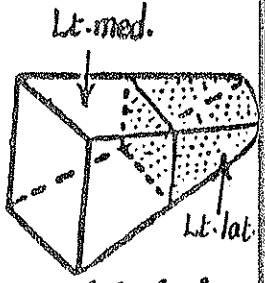


- on the basis of intrahepatic distribution of hepatic a., portal v. & biliary ducts, the liver is divided into 2 nearly equal lobes (Rt. & Lt.) by an antero-posterior plane passing through the gall bladder fossa & groove for I.V.C.

- the surgical Rt. lobe is further divided into:
  - (a) Ant. segment.
  - (b) post. segment.
  } each of which is subdivided into sup. & inf. subsegments.

- the surgical Lt. lobe is also divided into 2:
  - (a) lat. segment
  - (b) med segment
  } each of which is subdivided into sup. & inf. subsegments.





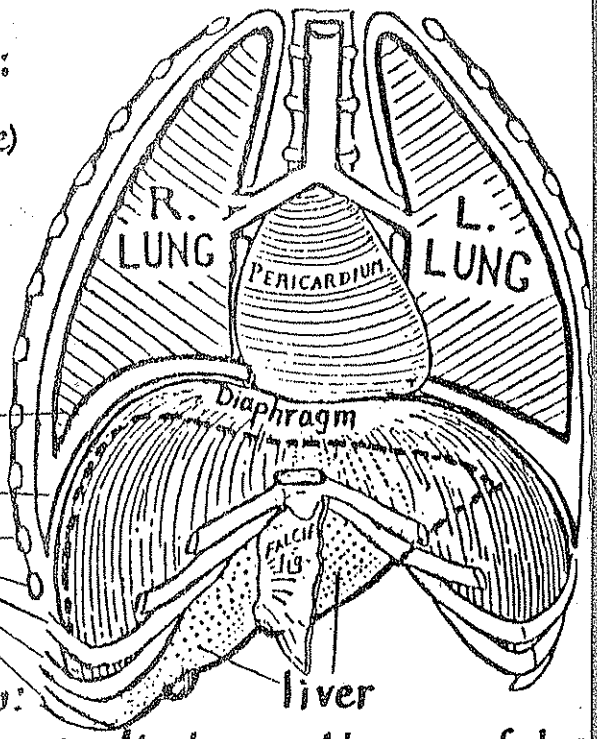
Relations of the liver

I- Superior Surface:

is related to the diaphragm separating it from:
(1) bases of both lungs & pleurae (on either side)
(2) pericardium & heart (in the middle).

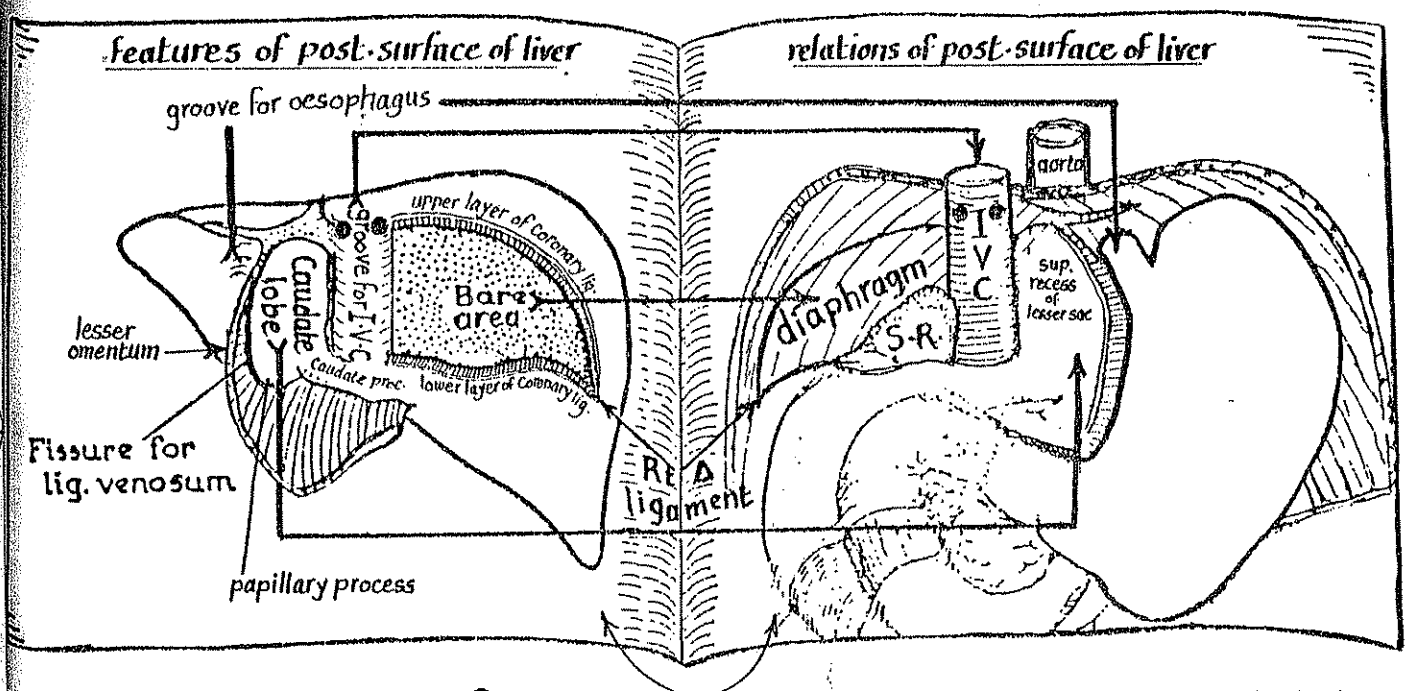
II-Right lateral Surface:

is related to the diaphragm separating it from:
(1) base of the right lung
(2) Costo-diaphragmatic recess of Rt. pleura
(3) ribs of the Rt. side (from 7 to 11).



III-Anterior Surface:

gives attachment to falciform lig. & is related to:
(1) diaphragm, separating this surface from Rt. costo-diaphragmatic recess of pleura
(2) the costal margins
(3) the anterior abdominal wall (in the middle part between the 2 costal margins).



IV-Posterior Surface : presents the following features (from Lt. to Rt.):

(1) **oesophageal groove** : on the post. aspect of Lt. lobe close to fissure for ligamentum venosum & is related to the abdominal part of oesophagus.

(2) **fissure for ligamentum venosum**: lodges the lig. venosum (obliterated ductus venosus of the foetus) & gives attachment to the lesser omentum.

(3) **Caudate lobe** : related to the upper recess of the lesser sac & the diaphragm separting it from the descending thoracic aorta.

(4) **groove for the I.V.C** : it lodges the upper part of the I.V.C. It shows 2-3 openings for the hepatic veins in its upper part

N.B : occasionally, the groove is bridged over by part of liver tissue, called pons hepatis, transforming it into a tunnel.

(5) the **bare area** : it is a triangular area devoid of peritoneal covering & is directly related to the diaphragm & Rt. suprarenal gland.

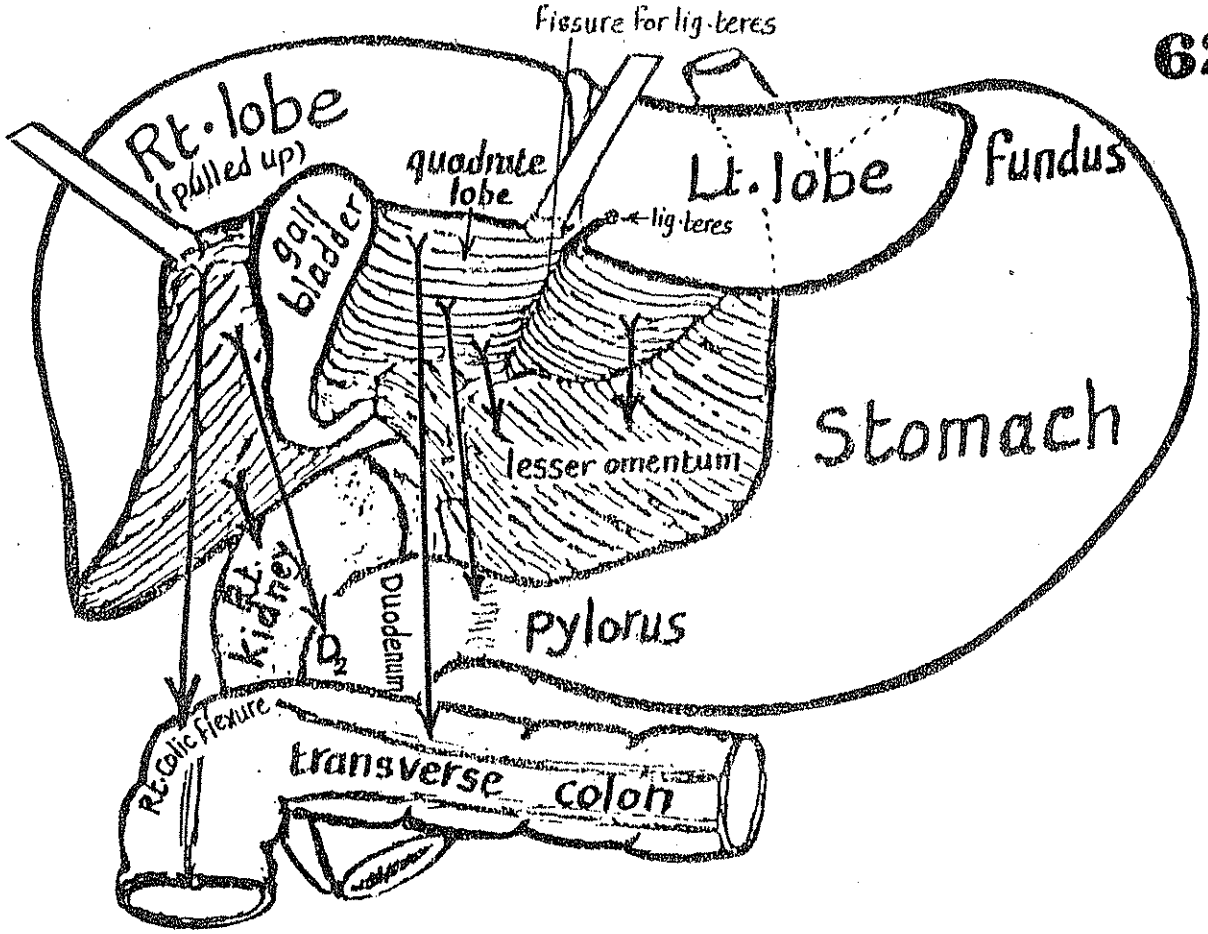
It is bounded by:

(a) the groove for I.V.C ---------- to the Lt. forming its base.

(b) the upper layer of coronary lig ------ above.

(c) " lower " " " " -----below.

(d) the apex : is formed by the meeting of the 2 layers of the coronary lig. on the Rt. side to form the right triangular lig.



V- Inferior (visceral) Surface of the liver :

- it is directed downwards, to the Lt & slightly backwards. It includes :

(A) **Inf. surface of the Lt. lobe** is related to :

(1) **Stomach** : related to the greater part of this surface (gastric impression).

(2) **lesser omentum** : related to an elevation called tuber omentale between the gastric impression & the fissure for ligamentum teres.

N.B: **tuber omental of liver** is related to the ant. surface of lesser omentum.
" " " **pancreas** " " " " **post.** " " " " .

(B) **Fissure for ligamentum teres** : lodges the lig. teres (obliterated Lt. umbilical v.).

(C) **Quadrate lobe** : lies to the Rt. of fissure for lig. teres & is related to :

(a) lesser omentum ——— : posterosuperiorly.
(b) pyloroduodenal junction —— : in the middle.
(c) transverse colon ——— : antero-inferiorly.

(D) **Gall bladder fossa** : is related to the anterosuperior surface of gall bladder

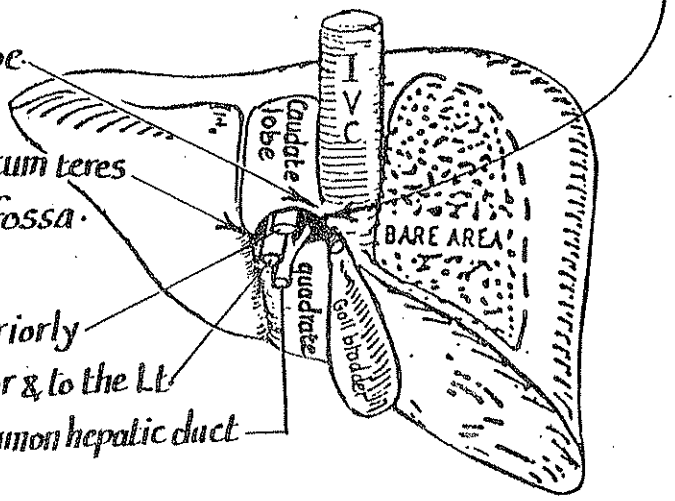
(E) **Inf. surface of Rt. lobe, to the Rt. side of gall bladder fossa**, is related to :

(1) upper portion of 2nd part of duodenum : lat. to the neck of gall bladder.
(2) Rt. colic flexure : in the ant. part of the inf. surface, close to the inf. border of liver
(3) front of Rt. kidney : behind the duodenal & colic impressions.

(F) Porta hepatis (Hilum of the liver):

* **Site**: it is a deep transverse slit 2" long on the post. part of inf. surface of liver.
* **Boundaries**:

(1) posteriorly: caudate process of caudate lobe.
(2) anteriorly: quadrate lobe of liver.
(3) to the Lt.: post. end of fissure for ligamentum teres
(4) to the Rt.: post. end of the gall bladder fossa.



* **Contents (structures passing through it)**:

(1) portal v. & its 2 branches (Rt. & Lt.): posteriorly
(2) hepatic a. & its 2 branches (" " "): anterior & to the Lt
(3) the 2 hepatic ducts uniting to form the common hepatic duct anterior & to the Rt.
(4) hepatic plexus of autonomic nerves: around the hepatic a. & its branches.
(5) lymphatic vessels & 2-3 hepatic L.Ns & amount of fat.

Peritoneal Covering & Connections of the liver

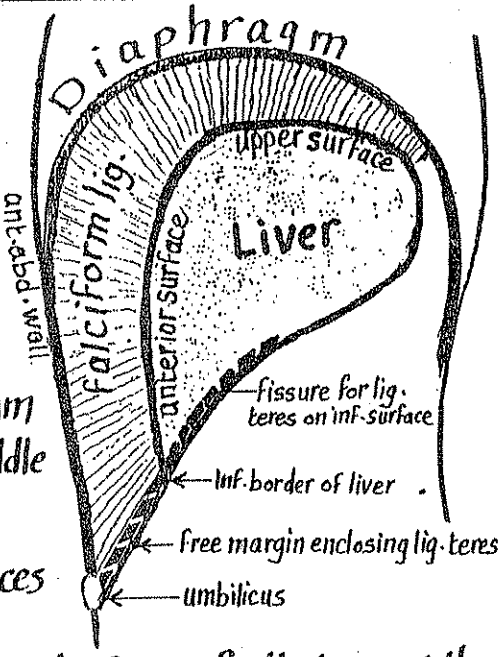
* The liver is completely covered with peritoneum except the following "bare areas":

(1) the bare area on the post. surface
(2) fossa for gall bladder.
(3) groove for I.V.C " " " "
(4) bottom of the porta hepatis.
(5) bottom of fissure for lig. venosum.
(6) bottom of fissure for ligamentum teres.

* The liver gives attachment to 5 peritoneal folds as follows:

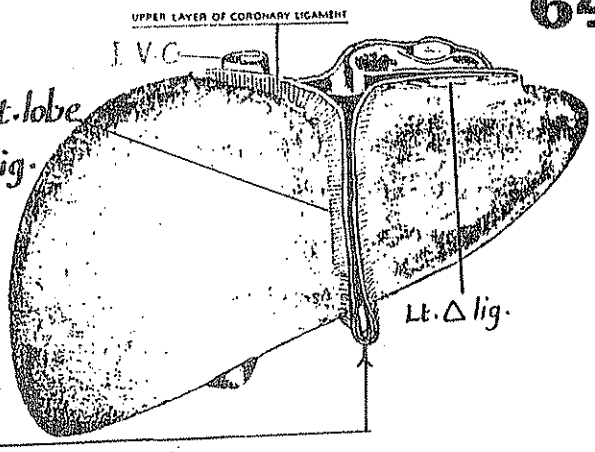
1- Falciform ligament:

* **Shape**: it is a sickle-shaped fold of peritoneum connecting the liver to the diaphragm & ant. abd. wall. It represents the ant. part of the ventral mesogastrium of the embryo.
* **Borders & attachments**: it has 3 margins:



(a) Convex margin: attached to the under surface of diaphragm & inner surface of ant. abd. wall (a little to the Rt of middle line) down to the umbilicus.
(b) Concave margin: is attached to the upper & ant. surfaces of liver down to its inferior border.
(c) Free margin: extends from the umbilicus to the ant. end of fissure for lig. teres at the inf. border of the liver.

*Layers of the falciform lig.:



(a) Rt. layer: continuous with the peritoneum of Rt. lobe of liver including the upper layer of the Coronary lig.

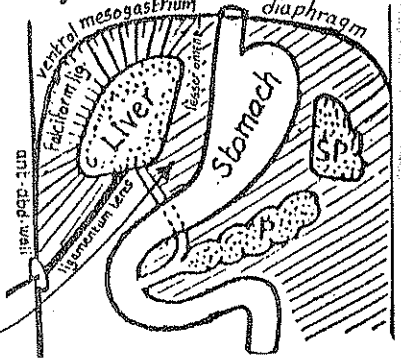
(b) Lt. layer: continuous with the peritoneum of Lt. lobe of liver including the ant. layer of Lt. Δ lig.

N.B: at the free margin of the falciform lig. the two layers are continuous with each other, enclosing the round lig. of the liver (ligamentum teres)

*Contents of falciform lig.:
- (1) ligamentum teres
- (2) para-umbilical veins
- } in its free margin
- (3) extraperitoneal fatty tissue: between the 2 layers of the lig.

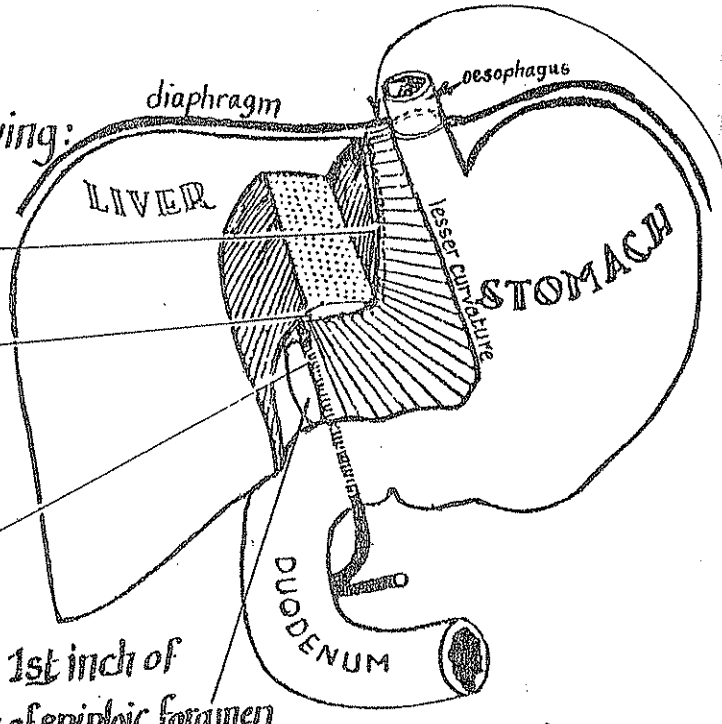
N.B: Ligamentum teres: is the Lt. umbilical v. of the embryo which undergoes fibrosis
- its lower end is attached to the inner surface of the umbilicus.
- it runs first in the free margin of falciform lig. then in the fissure for lig. teres of liver.
- its upper end it attached to the Lt. branch of portal vein in the porta hepatis.

II- Lesser omentum (gastrohepatic Ligament):



*Definition: it is a double-layered fold of peritoneum connecting the liver to the lesser curvature of stomach & the 1st inch of duodenum. It represents the dorsal part of the ventral mesogastrium of the embryo

*Borders & attachments:



(1) Hepatic border: is L-shaped having:
- (a) long vertical limb: attached to the fissure for ligamentum venosum
- (b) short horizontal limb: attached to the lips of porta hepatis

(2) Gastric border: attached to lesser curvature of stomach & the 1st inch of duodenum.

(3) Right free border: extending from porta hepatis to the 1st inch of duodenum forming the ant. boundary of epiploic foramen

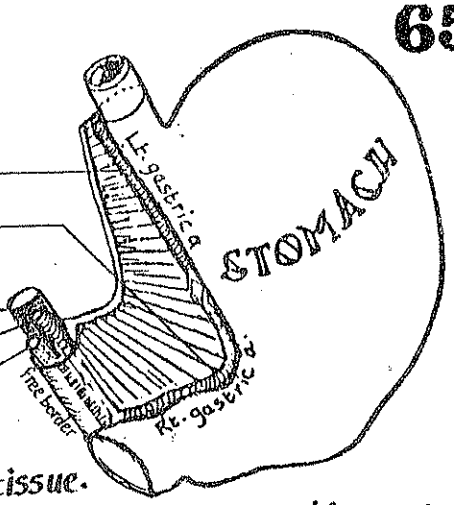
(4) Upper (diaphragmatic) border: attached to the undersurface of diaphragm then the 2 layers of the omentum enclose the abdominal part of the oesophagus.

*Contents of the lesser omentum:

(A) along the gastric border { (1) Lymphatics & L.Ns; (2) Lt. gastric vessels; (3) Rt. gastric vessels

(B) in the right free border (V.A.D) { (4) portal Vein; (5) hepatic Artery; (6) common bile Duct

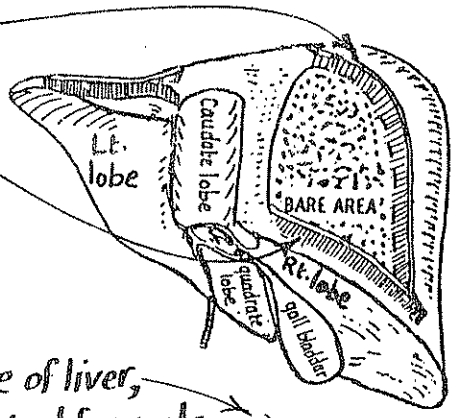
(C) between the 2 layers { (7) extraperitoneal fatty tissue; (8) hepatic plexus of autonomic nerves (around hepatic a.).



III- Upper layer of Coronary ligament

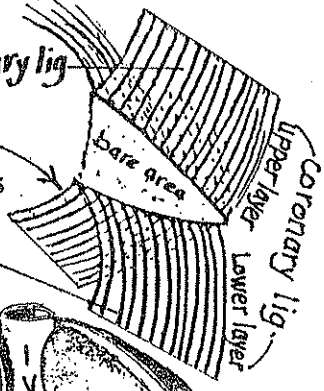
IV- Lower layer of Coronary ligament:

* the Rt. lobe of the liver is covered with peritoneum except the bare area which is devoid of peritoneum & comes into direct contact with the diaphragm.



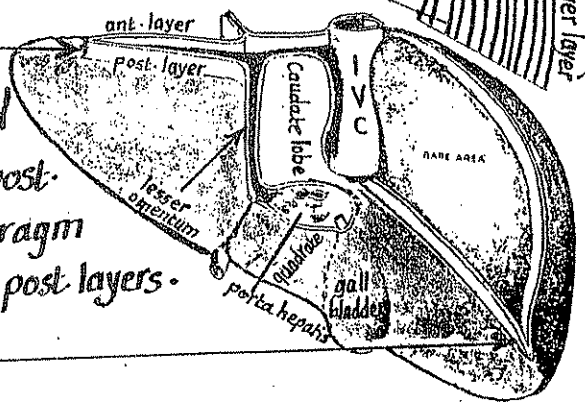
* the peritoneum on the upper surface of the right lobe of liver, on reaching the upper border of the bare area is reflected forwards onto the under surface of the diaphragm forming the upper layer of coronary lig.

* the peritoneum on the inferior surface of the right lobe of liver, on reaching the lower border of the bare area, is reflected downwards infront of the Rt. kidney to form the lower layer of the coronary lig.



V- Left triangular ligament:

the Lt. lobe of the liver is completely covered with peritoneum which is reflected from the post. part of of the upper surface on to the diaphragm forming the Lt. triangular lig. which has ant. & post. layers.



VI- Right triangular ligament:

It is a peritoneal fold extending from the Rt end of the bare area of liver to the under surface of the diaphragm. It is formed by the meeting of the 2 layers of the coronary ligament.

N.B: 2 obliterated Vascular ligaments are attached to the liver:

(1) Ligamentum teres: obliterated Lt. umbilical vein (see p. 64 for its attachments).

(2) Ligamentum venosum: represents the obliterated ductus venosus of the embryo. It extends from the Lt. branch of portal V. to the I.V.C & lies in the Fissure for lig. venosum.

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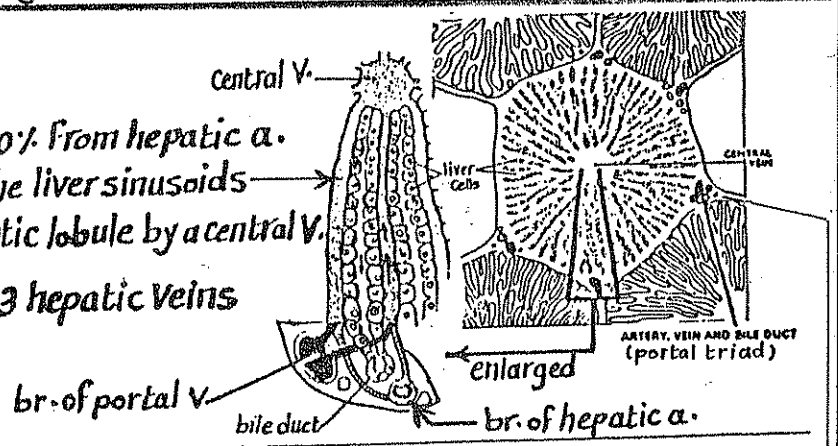
* **Fixation of the liver:** stability of the liver in its position depends on:
(1) the attachment of the hepatic veins emerging from the liver to the fixed I.V.C.
(2) peritoneal ligaments attaching the liver to the diaphragm & abdominal walls.
(3) the positive intra-abdominal pressure & the pressure of the surrounding organs.

---

* **Nerve Supply of the liver:** the liver receives nerve supply from the hepatic plexus containing
(1) Sympathetic fibres: derived from the Coeliac plexus.
(2) parasympathetic fibres: From the ant. & post. vagal trunks.
N.B: the hepatic plexus runs around the hepatic artery. Some nerve fibres also reach the liver via its various peritoneal ligaments.

---

* **Blood Supply of the liver:**
- it is 70% from portal V. & only 30% from hepatic a.
- blood of both vessels is mixed in the liver sinusoids
- the blood is collected from each hepatic lobule by a central V.
- the central veins unite to form 2-3 hepatic veins which open into the I.V.C.



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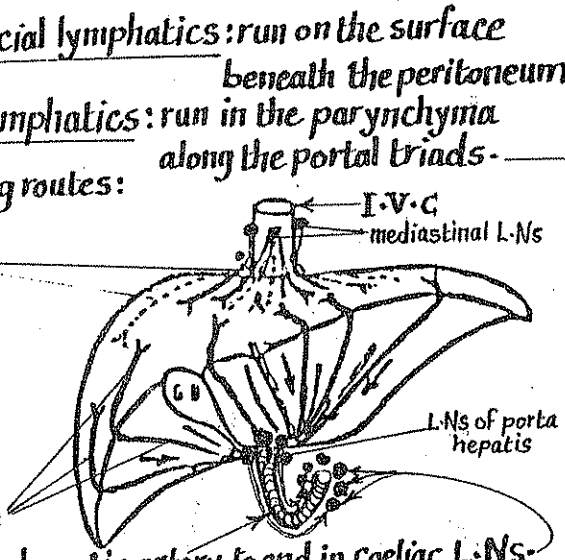
* **Lymphatic drainage:**
- the liver has 2 sets of lymphatics: (a) superficial lymphatics: run on the surface beneath the peritoneum. (b) deep lymphatics: run in the parynchyma along the portal triads.
- Lymphatics of both sets pass through the following routes:

(1) Lymphatics of the post. part of the liver:
(a) most of them follow the I.V.C upwards to end in mediastinal L.Ns in the thorax
(b) Some lymphatics pass to phrenic L.Ns then to the Coeliac group of L.Ns.

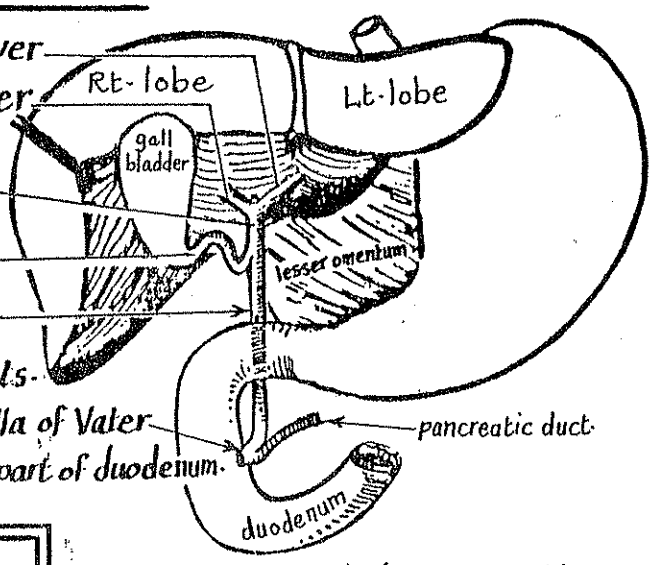


(2) Lymphatics of the ant. & inf. aspect of the liver: pass to 2-4 L.Ns in the porta hepatis then follow hepatic artery to end in Coeliac L.Ns.
(3) few lymphatics from post. surface of Lt. lobe end in left gastric L.Ns.
(4) " " " central part of ant. surface run along falciform lig. → parasternal L.N
(5) " " pass along ligamentum teres to communicate with lymphatics around umbili

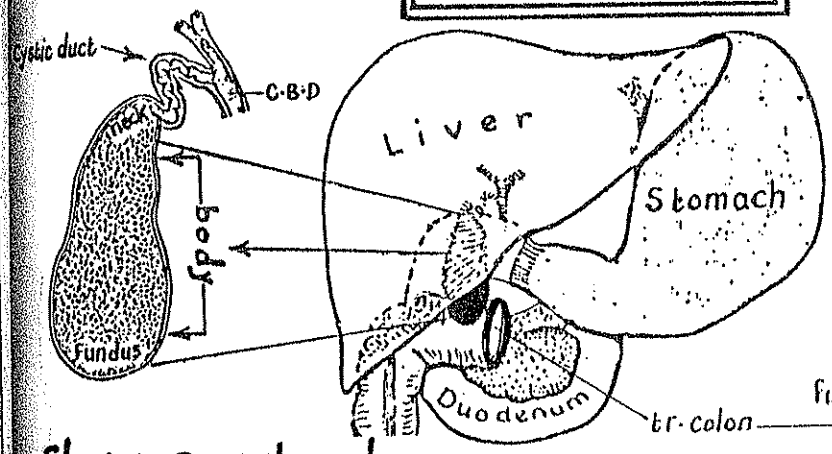
EXTRA-HEPATIC BILIARY PASSAGES

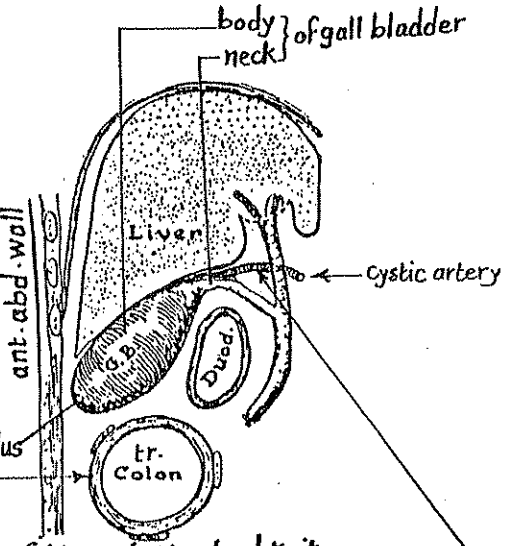
(Excrelory apparatus of the liver)

(1) Lt. hepatic duct emerging from Lt lobe of liver
(2) Rt hepatic duct " " Rt lobe of liver
(3) Common hepatic duct : formed by the union of Rt. & Lt. hepatic ducts.
(4) gall bladder & its cystic duct
(5) Common bile duct : formed by the union of common hepatic & cystic ducts. & ends by joining the pancreatic duct to form ampulla of Vater which opens into the posteromedial aspect of 2nd part of duodenum.



Gall bladder



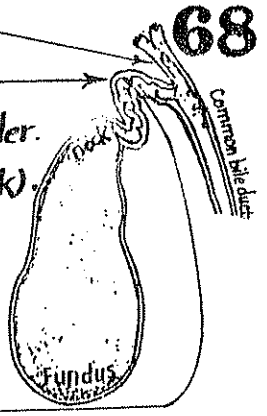


* **Shape:** Pear-shaped.
* **Site:** gall bladder fossa on the inf. surface of Rt. lobe of liver. (attached to it by loose C.T. & by small veins passing from gall bladder to the liver).
* **Size:** 7–10 cm. long & 3 cm. broad (at its widest part) & about 30–50 cc in capacity.
* **Parts & relations:** it consists of fundus, body & neck.:

(A) **Fundus** : is the expanded lower end which projects beyond the inf. border of the liver.
- Relations : anteriorly : ant. abdominal wall below tip of 9th costal cartilage
posteriorly : transverse colon.

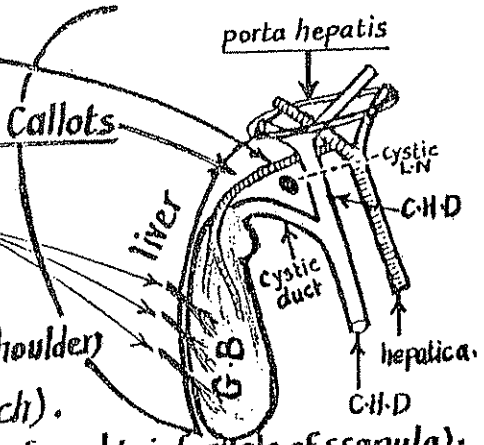
(B) **Body:** in contact with G.B. fossa of liver. It is coverd by peritoneum inferiorly.
- Relations : anterosuperiorly : liver.
postero inferiorly : tr. colon & 1st part of duodenum.

(C) **Neck** : it is the narrow upper end of G.B which is continuous with the cystic duct.
- its posteromed. wall is dilated to form Hartmann's pouch.
- Relations : - sup.: liver, with cystic artery inbetween
inf. : end of 1st part of duodenum.



(D) Cystic duct: (duct of the gall bladder):

- it is S-shaped duct about $1\frac{1}{2}$" long, continuous with the neck of gall bladder.
- it runs downward, backwards & to the left (making S-shaped bend with the neck).
- it ends by joining the common hepatic duct at an acute angle to form the common bile duct below the Rt. end of the porta hepatis.
- its mucous membrane projects into the lumen forming a spiral ridge called "Spiral valve of Heister".



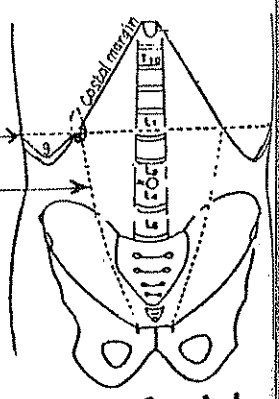
***Arterial Supply of gall bladder: Cystic artery:**
arises from Rt. br. of hepatic a. & passes in the Δ of Callots (between cystic duct, R.H.D., C.H.D & inf. surface of liver).

***Venous drainage:** cystic veins: open directly into liver & also in the Rt. branch of portal vein.

***Nerve supply:**
- sensory: Rt. phrenic n: $C_{3,4,5}$ (pain referred to Rt shoulder)
- parasymp.: Rt. vagus (pain via vagus is referred to stomach).
- symp.: T7–9 by greater splanchnic n. (pain via symp. is referred to inf. angle of scapula).

***Lymphatic drainage:** into cystic & hepatic L.Ns.

***Surface anatomy of the fundus of gall bladder:** it corresponds to:
(1) a point at the tip of the Rt. 9th costal cartilage.
(2) the junctional point of the Rt. costal margin with the transpyloric plane
(3) " " " " " " " " " linea semilunaris (the lat. edge of the Rt. rectus abdominis muscle).

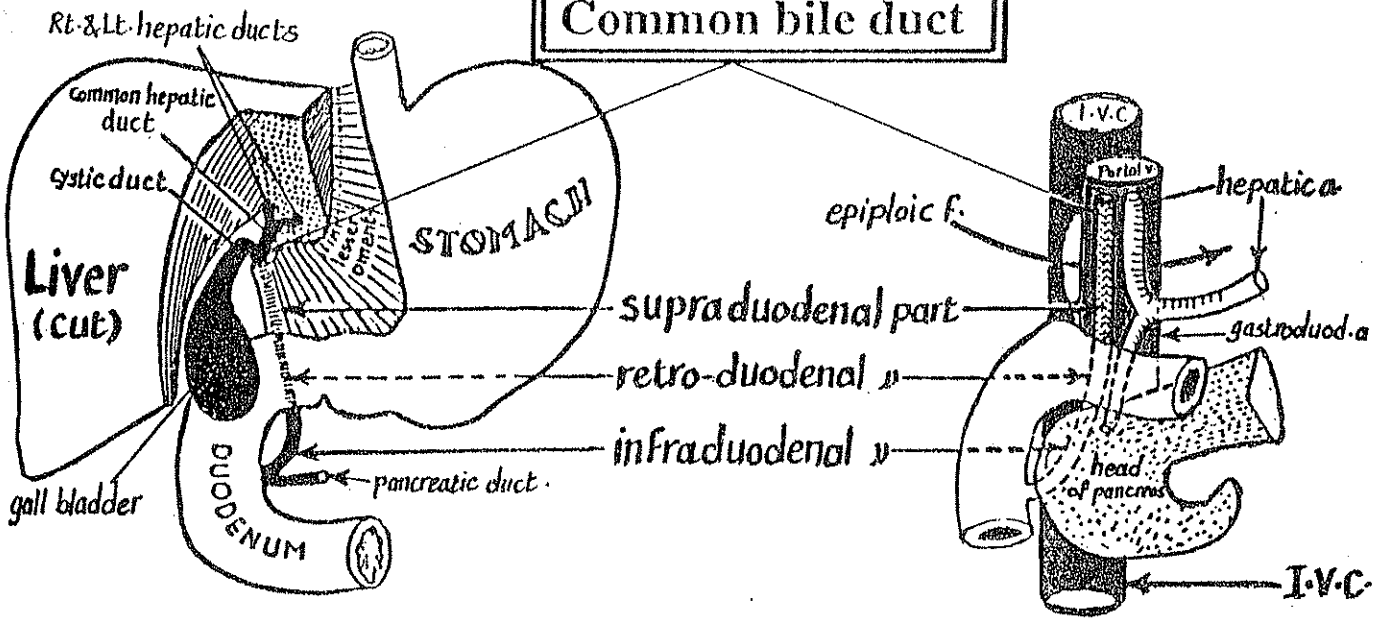


***Peritoneal Covering of gall bladder:**
(1) the fundus: is completely covered with peritoneum
(2) the body: its postero-inferior surface & sides are covered while its anterosuperior surface is bar
(3) the neck: " " " " " " " " " " " " " " "

- Hepatic ducts:
- A right & a left hepatic duct drain the bile from the Rt. & Lt. lobes of the liver
- they emerge from porta hepatis, lying infront of the branches of the hepatic a. & the portal v.
- the 2 ducts unite in the Rt. part of the porta hepatis to form the Common hepatic duct.

- Common hepatic duct:
- it is a short duct (about 1" long) formed by the union of the Rt. & Lt. hepatic ducts.
- it descends infront of the portal V. & on the Rt. side of the hepatic artery
- it ends by joining the Cystic duct at acute angle to form the Common bile duct.

Common bile duct

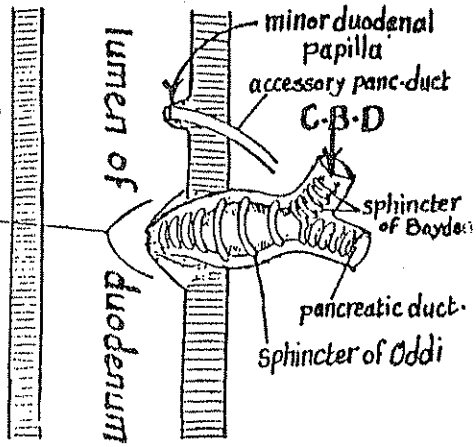


* **Formation**: it is formed below the porta hepatis by the union of the cystic & common hepatic ducts.
* **Length & parts**: it is about 3" long & is divided into 3 parts: supra-duodenal, retro-duodenal, infra-duodenal.
* **Course & relations**:

	Part	Course	relations
1-	Supraduodenal	descends in the free margin of lesser omentum	-Anteriorly: liver. -posteriorly: portal v., epiploic f. -on the Rt. side: hepatic artery.
2-	Retroduodenal	descends behind the 2nd inch of 1st part of duoden.	-ant.: 1st part of duodenum -post.: portal V. & I.V.C. -on the Rt. side: gastroduodenal a.
3-	Infraduodenal	passes in a groove on the post. surface of the head of pancreas, or even embedded in it	-ant.: head of pancreas (it may be compressed by cancer head → obstructive jaundice). -post.: I.V.C.

* Termination of C.B.D:

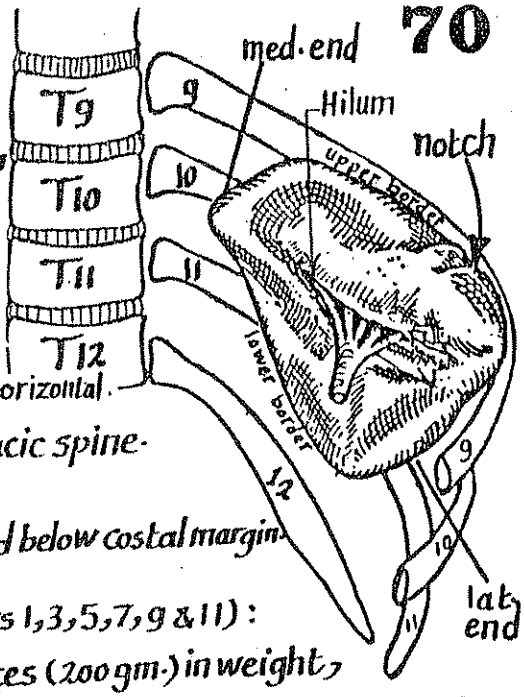
the terminal part of the C.B.D unites with the main pancreatic duct to form the **ampulla of Vater** which opens at the summit of the **major duodenal papilla** at the middle of the posteromedial aspect of 2nd part of duodenum (surrounded by the **sphincter of Oddi**).



N.B: (1) the C.B.D may open separately in the lumen of the duodenum.
(2) the intra-mural part of the C.B.D, before entering the ampulla, is surrounded by the sphincter of **Boyden**.

* **Arterial Supply of the C.B.D**: upper part: by cystic a. or Rt. hepatic a.; lower part: by sup. pancreatico-duodenal a.

spleen



*Nature: Lymphatic organ connected to the vascular system.

*Site: it lies obliquely in the post. part of Lt. hypochondrium wedged between the fundus of stomach & the diaphragm.

*Surface anatomy:

- it lies opposite the ribs 9, 10 & 11 with its long axis parallel to the 10th rib. making an angle of 45° with the horizontal.
- its post. (med.) end lies 1½ inches from the 10th thoracic spine.
- its ant. (lat.) end reaches the Lt. midaxillary line.

N.B: normally, the spleen is not palpable as it does not extend below costal margin.

*Size & weight: (easy to remember by the odd numbers 1, 3, 5, 7, 9 & 11):
The avarage spleen is 1" thick, 3" broad, 5" long, 7 ounces (200 gm.) in weight, & is related to the 9-11 ribs.

*Shape & features: it is shaped as cupped hand, having:
- 2 ends: med. (post.) & lat. (ant.).
- 2 borders: upper & lower
- 2 surfaces: diaphragmatic & visceral.

(1) Medial (post.) end: is rounded. It is directed upwards, backwards & medially lying 1½ inches from the median plane.

(2) Lateral (ant.) end: is expanded (resembles a border). It is directed downwards & forwards, reaching the Lt. midaxillary line. It rests on phrenicocolic lig.

(3) Upper border: is sharp & notched near its ant. end & terminates laterally by an angle.

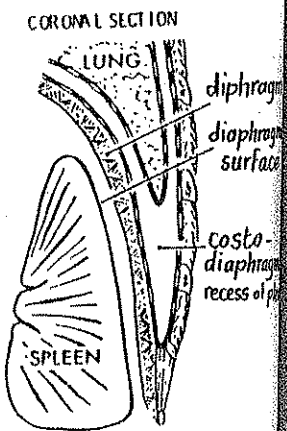
N.B: notching of the upper border is an indication of foetal lobulation.

(4) Lower border: is thick, rounded & smooth (presenting no notches).

(5) Diaphragmatic surface: is convex, smooth & related to the diaphragm.

(6) Visceral Surface: concave, irregular & related to abdominal viscera. It presents the hilum & impressions for the related viscera.

* Relations of the Spleen



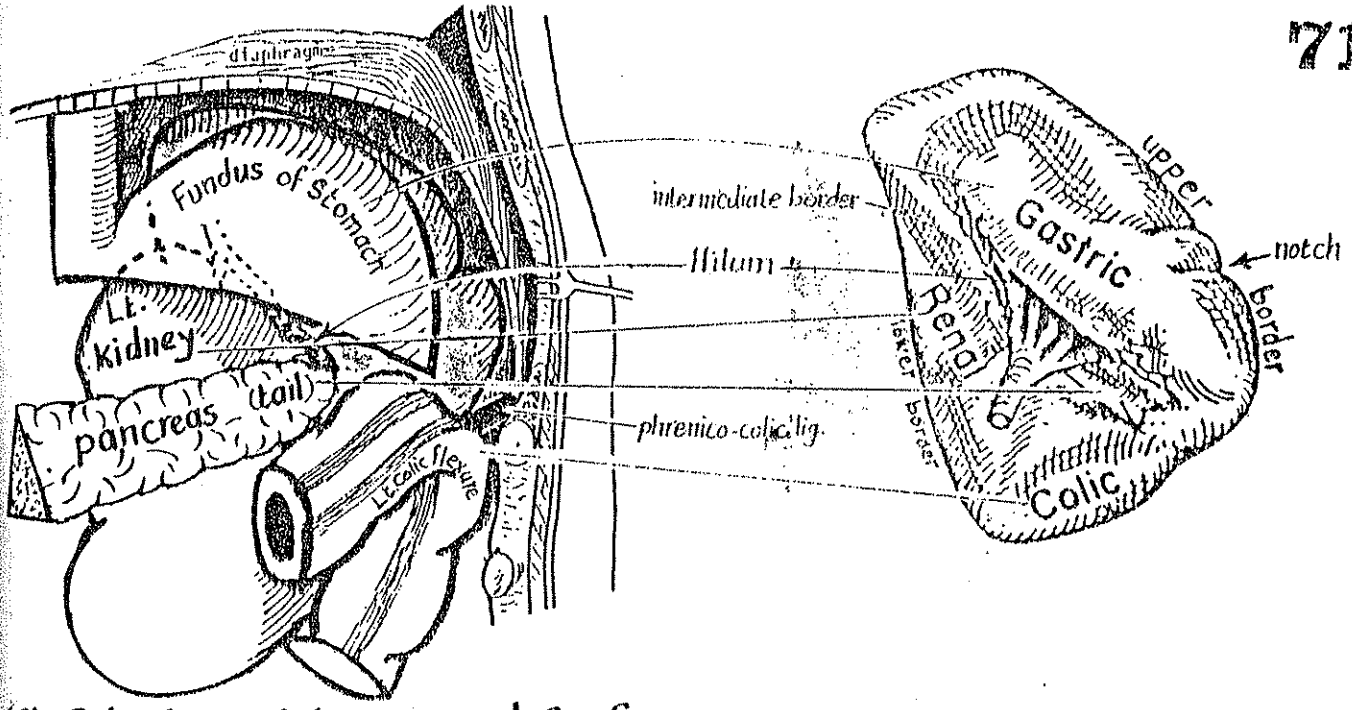
(A) The Diaphragmtic surface:

is related to the diaphragm which separates the spleen from:

(1) lower part of the Lt. pleura (Costodiaphragmatic recess).

(2) " " " " Lt. lung

(3) post. parts of the 9th, 10th & 11th ribs & their intercostal muscles.



(B)- Relations of the Visceral Surface :

(1) Gastric impression: it is a large concave area between the hilum & the upper border. It is related to the post.-wall of the fundus of stomach.

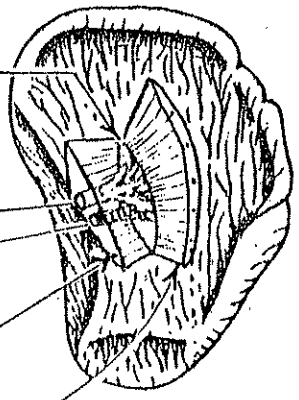
(2) Renal impression: a small shallow impression between the hilum & the lower border. It is related to the front of the left kidney.

N.B : the gastric & renal impressions are separated by a raised margin (intermediate border).

(3) Pancreatic impression: a small impression below the lateral end of the hilum. It is related to the tail of the pancreas.

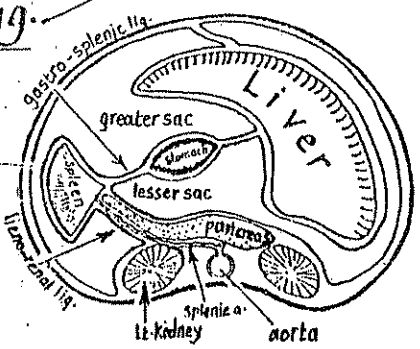
(4) Colic impression : a flat area close to the lat.-end of the spleen. It is related to the Lt.-colic flexure & its lower part is related to the phrenico-colic ligament.

* Hilum of the Spleen :



- It is a longitudinal slit on the visceral surface between the gastric & colic impressions.
- It transmits : (1) terminal branches of splenic artery
  (2) tributaries of the splenic vein
  (3) autonomic nerves & lymphatics.
- It gives attachment to 2 ligaments : (1) Lienorenal lig.
  (2) gastrosplenic lig.

* Peritoneal relations of the spleen :



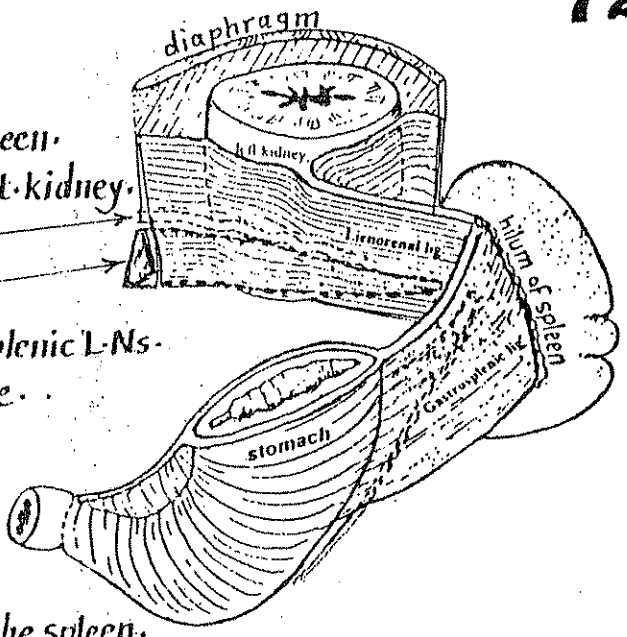
- the spleen is completely covered with peritoneum of the greater sac except the pancreatic impression.
- its hilum forms the left lateral extrimity of the lesser sac (between the gastrosplenic & lieno-renal ligament).

*Peritoneal ligaments of the spleen:

(1) Lienorenal ligament:

*Attachments: it extends between:
(a) lower part of the hilum of spleen.
(b) the front of the upper ½ of Lt. kidney.

*Contents: (1) splenic vessels.
(2) tail of pancreas.
(3) lymphatics & pancreaticosplenic L.Ns.
(4) extraperitoneal fatty tissue.
(5) autonomic nerve fibres.



(2) Gastrosplenic ligament:

*Attachments: it extends between:
(a) upper part of the hilum of the spleen.
(b) upper ⅓ of the greater curvature of the stomach.

*Contents: (1) short gastric vessels. (2) Lt. gastro-epiploic vessels.
(3) autonomic nerve fibres. (4) extraperitoneal fatty tissue.
(5) lymph vessels & pancreatico-splenic L.Ns.

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*Stability of the Spleen: depends on:
(1) the intra-abdominal pressure (2) position of the surrounding organs
(3) the ligaments: (a) gastrosplenic lig. (b) lienorenal lig. (c) phrenico-colic lig. which extends below the spleen, between the Lt. Colic flexure & the diaphragm.

---

*Arterial Supply: Splenic artery:
- arises as the largest branch of the coeliac trunk.
- it runs a tortuous course along the upper border of the body of pancreas.
- it enters the lienorenal lig. to reach the hilum of the spleen to end by dividing into 5-6 branches.

*Venous drainage: Splenic vein:
- aries at the hilum of the spleen then enters the lienorenal ligament.
- it runs a straight course behind the pancreas.
- it ends by joining the superior mesenteric v. to form the portal V.

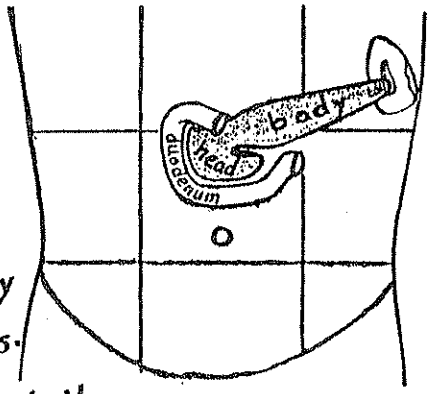
*Lymphatic drainage: red bulb of the spleen has No lymphatics but few lymphatics arise from the capsule & trabeculae & drain into the pancreaticosplenic L.Ns (along splenic a.).

*Nerve Supply: Sympathetic vasomotor fibres from the coeliac plexus.

*How to place the spleen in the correct anatomical position?:

(1) hold the spleen in your left hand with its convex (diaphragmatic) surface applied to the palm, the rounded post. end towards the wrist, the broad ant. end towards the tips of fingers & the notched upper border applied to the thumb.
(2) put your hand behind the Lt. midaxillary line, with an angle of 45 degrees with the horizontal.

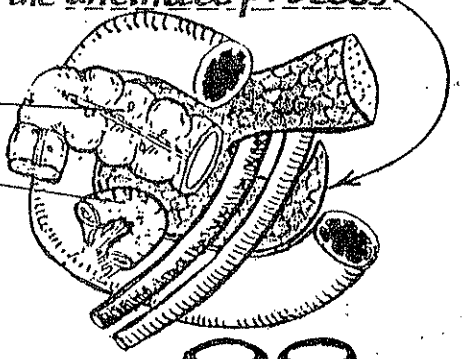
pancreas



* **Type**: a mixed gland (exocrine & endocrine).
* **Site & shape**: it is an elongated retroperitoneal gland lying transversely across the post-abdominal wall extending from the concavity of the duodenum on the right to the hilum of the spleen on the left. It lies mainly in the lower part of epigastric & Lt-hypochondrial regions.
* **parts & relations**: it is formed of head, neck, body & tail:

I- The head:

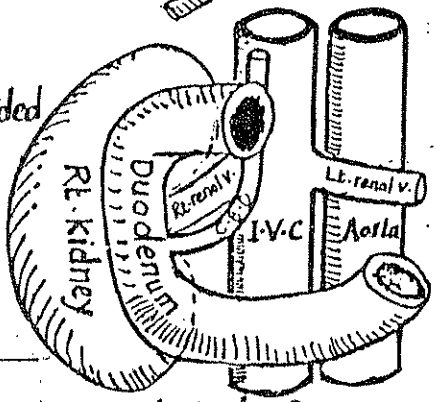
- it is the expanded right part occupying the concavity of the duodenum
- it is flattened (having ant-& post-surfaces) and its lower left part sends a hook-like projection behind the sup-mesenteric vessels called the **Uncinate process**



(A) **Anterior relations**: (T-C-S):
(1) Transverse colon: infront of its upper part
(2) Coils of jejunum: infront of its lower part
(3) Sup. mesenteric vessels: infront of uncinate process.

(B) **Superior, lateral & inferior relations**: the duodenum

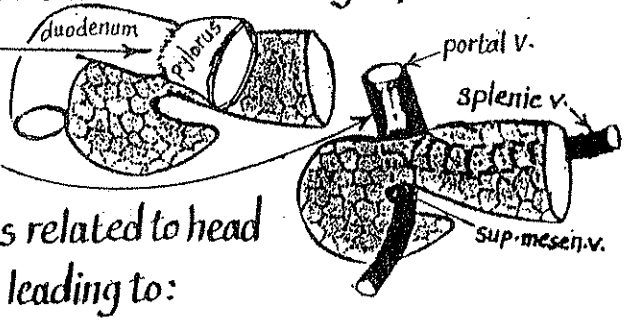
(C) **Posterior relations**: Veins, Artery, Duct



(1) Common bile Duct: behind the upper lat-part (embedded in the back of the head).
(2) Inf. Vena cava & termination of Rt-& Lt-renal Veins
(3) Aorta: behind the uncinate process.

II- the Neck: is the constricted part at the Junction between the head & body of pancreas.

(A) Anterior relations: pyloroduodenal Junction
(B) posterior relations: Junction between splenic & sup-mesenteric veins to form the portal vein.

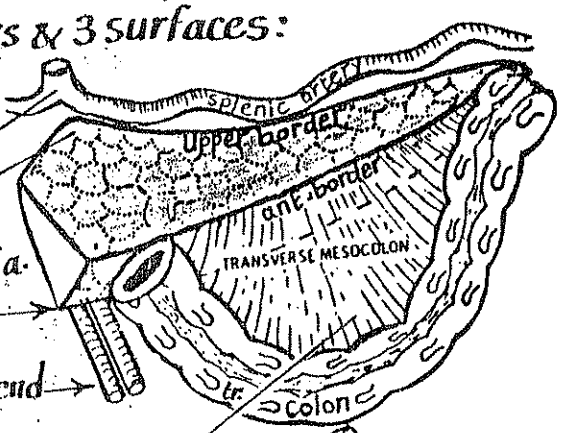


N.B: **Cancer head of pancreas** affects the structres related to head & neck of pancreas leading to:

(1) widening of the duodenal Concavity (appears in X-ray).
(2) Compression of the common bile duct ⟶ obstructive jaundice.
(3) " " " pyloroduodenal junction ⟶ Pyloric obstruction.
(4) " " " inferior vena Cava ⟶ oedema of lower limbs.
(5) " " " portal vein ⟶ ascitis (Fluid in the peritoneal cavity).

III- Body of pancreas:

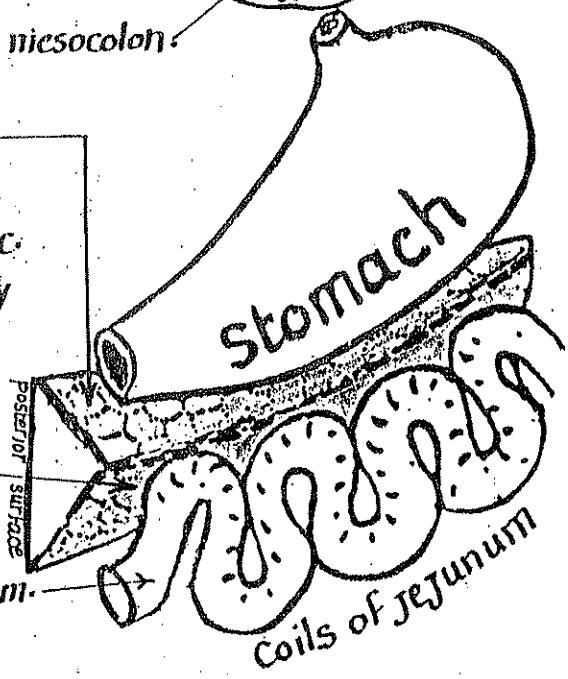
- extends to the Lt. & slightly upwards crossing the median plane opposite L1.
- It is triangular in cross section having 3 borders & 3 surfaces:



(1) **Superior border:**
- has an upward projection just below the coeliac trunk, called the omental tuberosity of the pancreas
- the rest of the superior border is related to the splenic a.

(2) **Inferior border:**
is related to superior mesenteric vessels at its Rt. end

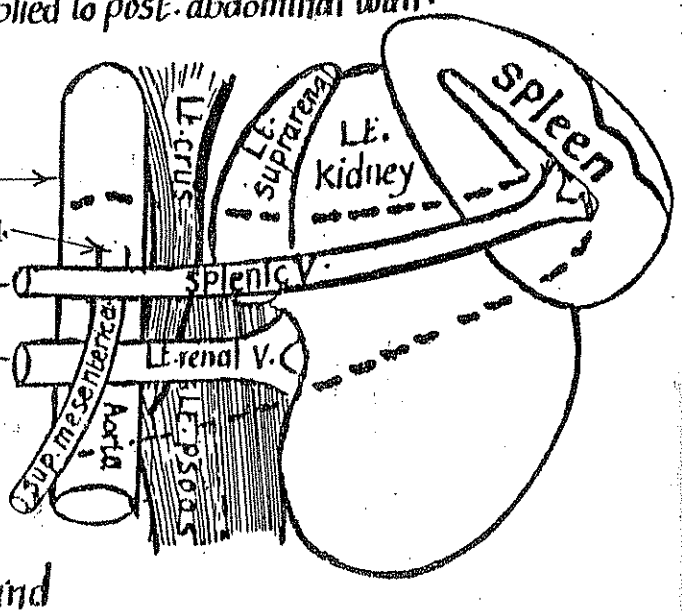
(3) **Anterior border:** gives attachment to transverse mesocolon.



(4) **Anterior surface:**
- is bounded by the superior & anterior borders.
- it is covered by the peritoneum of post. wall of lesser sac.
- it is related to the Stomach but separated from it by the cavity of the lesser sac.

(5) **Inferior surface:**
- is bounded by the anterior & inferior borders.
- it is covered by the peritoneum of the greater sac.
- it is related to duodenojejunal flexure & coils of jejunum.

(6) **Posterior surface:**
- it is bounded by the sup. & inf. borders & applied to post. abdominal wall.
- it is not covered by peritoneum.
- It is related to:



(A) 2 arteries
- (1) abdominal aorta
- (2) origin of sup. mesent. a.

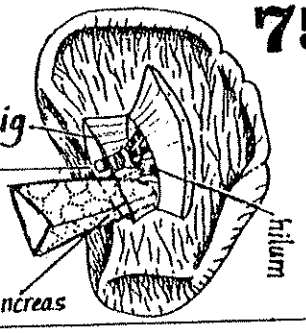
(B) 2 veins
- (3) splenic vein
- (4) Lt. renal vein

(C) 2 muscles
- (5) Lt. psoas major
- (6) Lt. crus of diaphragm

(D) 2 glands
- (7) Lt. kidney.
- (8) Lt. supra renal gland

IV- Tail of pancreas:

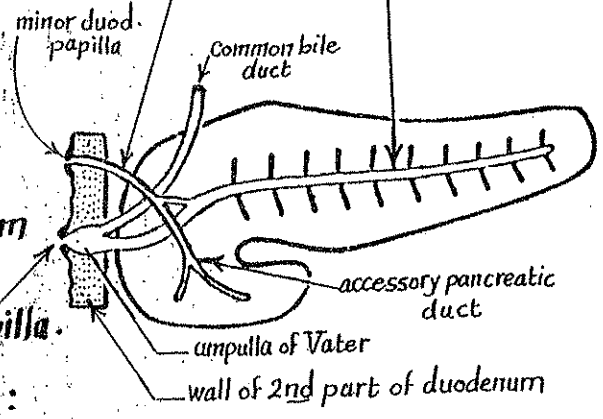
- it is the narrow left end of the gland which lies in the lienorenal lig. together with the splenic vessels
- it is related to the visceral surface of the spleen just below the lateral end of its hilum.



* Ducts of the pancreas: — main pancreatic duct — accessory pancreatic duct

(1) Main pancreatic duct (of Wirsung):

- begins in the tail & passes to the right towards the head traversing the whole length of the gland.
- emerges from the head & unites with the common bile duct inside the wall of the 2nd part of duodenum forming a dilatation called ampulla of **Vater** which opens on the summit of the major duodenal papilla.



(2) Accessory pancreatic duct (of Santorini):

- it is a small duct which drains the uncinate process & the lower part of the head.
- it runs upwards infront of the main pancreatic duct to open separately into the 2nd part of duodenum at the minor duodenal papilla, one inch above the major duodenal papilla.

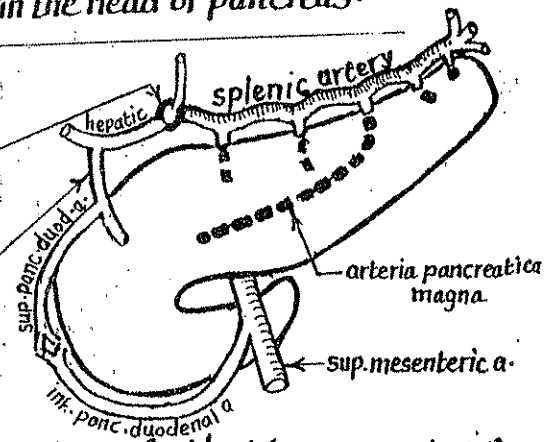
N.B: frequently, the main & accessory ducts communicate in the head of pancreas.

* Arterial Supply of pancreas:

(1) pancreatic branches of splenic a. (br. of coeliac trunk): supply the body.

(2) Sup. pancreatico-duodenal a. (br. of gastroduodenal a.): supply the upper part of the head.

(3) inf. pancreatico-duodenal a. (br. of sup. mesenteric a.): supply the lower part of the head.



N.B: the pancreas is supplied by the a. of foregut (Coeliac) & the a. of midgut (sup. mesenteric).

* Venous drainage:

(1) veins of the body: drain into the splenic vein.

(2) veins of the head: drain into portal vein directly.

* Lymphatic drainage: the lymphatics follow the arteries & drain into:

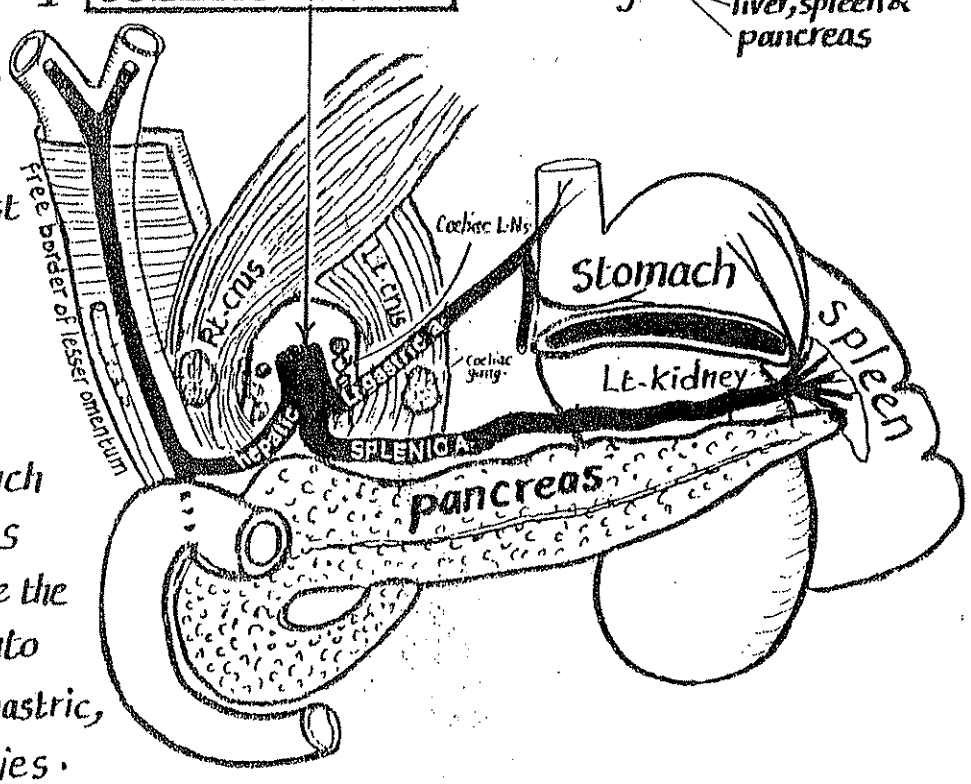
(1) the pancreaticosplenic L.Ns (around splenic a.)

(2) Coeliac L.Ns (around coeliac trunk).

(3) Sup. mesenteric L.Ns (along sup. mesenteric a.).

Arterial supply of the gut

I- COELIAC TRUNK : a. of foregut ← Stomach, upper ½ of duod, liver, spleen & pancreas



*Origin:

from the front of abdominal aorta opposite the upper border of L 1 vertebra, just below the aortic opening of the diaphragm.

*Course:

it is a short trunk ½ an inch long which passes forwards infront of the aorta, above the pancreas & soon divides into 3 terminal branches: Lt. gastric, hepatic & splenic arteries.

*Relations:

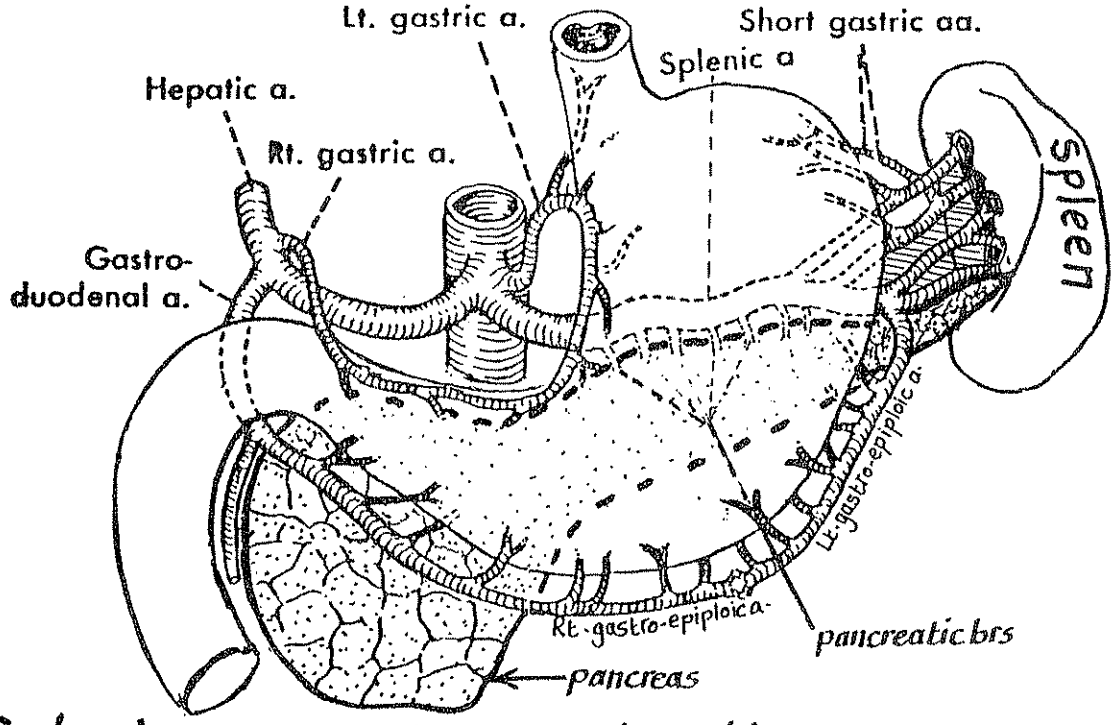
- on each side:
  (1) Coeliac ganglion & coeliac plexus of autonomic nerves.
  (2) Coeliac group of L. Ns (around it).
  (3) Rt. crus of diaphragm & caudate process of liver (on the Rt. side).
  (4) Lt. " " " & Cardiac end of the stomach (on the Lt. side).

- Anteriorly: cavity of the lesser sac of peritoneum, separating it from the lesser omentum
- Superiorly: median arcuate ligament of the diaphragm.
- Inferiorly: omental tuberosity of the pancreas.

*Branches:

1- Left gastric artery: (the smallest branch):

- it passes upwards & to the Lt. on the Lt. crus of the diaphragm (behind the lesser sac) to reach the lower end of the oesophagus.
- then it curves downwards & to the right along the lesser curvature of the stomach (between the 2 layers of the lesser omentum).
- it ends by anastomosing with the Rt. gastric a. about the middle of the lesser curvature
- Branches: (1) oesophageal brs. to the lower end of the oesophagus.
  (2) gastric branches: to both surfaces of the stomach.



2- Splenic artery (the largest branch):

* **Course & relations:**

- it runs, in a tortuous course, to the left along the upper border of the pancreas & infront of the Lt. kidney & Lt. suprarenal gland to enter the lieno-renal ligament.
- along its course it lies behind the stomach but separated from it by the cavity of the lesser sac
- it ends close to the spleen by dividing into 5-6 terminal brs. which enter the hilum

* **Branches:**

(1) pancreatic brs.: to the body & tail of pancreas. The largest of them is called the "arteria pancreatica magna" (see page 75).

(2) Short gastric arteries: 5-7 small brs. which arise from the terminal part of the splenic a. & enter the gastrosplenic lig. to supply the fundus of stomach.

(3) Lt. gastro-epiploic a.: arises near the hilum of the spleen then enters the gastrosplenic lig. to reach the stomach where it runs downwards along the upper 1/3 of the greater curvature (between the ant. 2 layers of greater omentum). It supplies both surfaces of the stomch + the greater omentum & ends by anastomosing with the Rt. gastro-epiploic a.

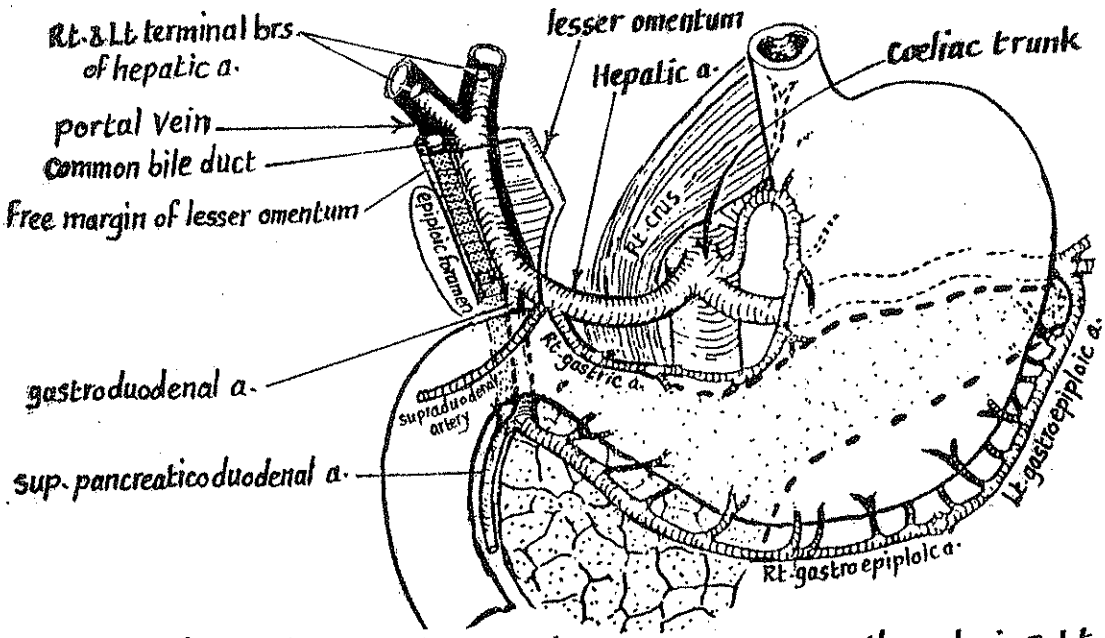
(4) Terminal Splenic branches: 5-6 end arteries which enter the hilum of the spleen.

N.B:1- Causes of tortuosity of the splenic artery:

(a) to accomodate for enlargement of the spleen & its movement during respiration.
(b) to slow the circulation allowing blood to pass in the branches supplying the pancreas.

2- Other tortuous arteries in the body:

(a) facial a. (b) lingual a. (c) int-carotid a. (d) post-inf. cerebellar a. (e) uterine a.



(3) Hepatic artery: (intermediate in size between the splenic & Lt. gastric arteries).

* Course & relations:

- it passes forwards & to the right on the Rt. crus of the diaphragm & behind the lesser sac.
- it reaches the upper border of the 1st part of duodenum
- it curves upwards & ascends in the right free margin of the lesser omentum (infront of the epiploic foramen) having the portal V. behind it & the common bile duct on its Rt. side.
- it reaches the porta hepatis where it ends by dividing into Rt. & Lt. terminal branches.

* Branches:

(1) Gastro-duodenal a.:
- descends behind the 1st part of duodenum (infront of portal V. & medial to C. bile duct).
- it ends by dividing into:

(a) right gastro-epiploic a.: runs to the Lt. between the 2 layers of greater omentum, along the greater curvature of stomach (supplying both surfaces + the greater omentum) & ends by anastomosing with the Lt. gastro-epiploic a.

(b) sup. pancreatico-duodenal a.: descends between the head of pancreas & the duodenum (supplying both of them), then ends by anastomosing with the inf. pancreaticoduodenal a. (anastomosis between artery of foregut & artery of midgut).

(2) Right gastric a.: passes to the Lt. along the lesser curvature of stomach (between the 2 layers of the lesser omentum), supplying both surfaces of the stomach. It ends by anastomosing with the Lt. gastric a.

(3) Supraduodenal a.: a small inconstant a. supplying upper part of the 1st part of duodenum.

(4) Rt. terminal hepatic branch: enters the Rt lobe of the liver.

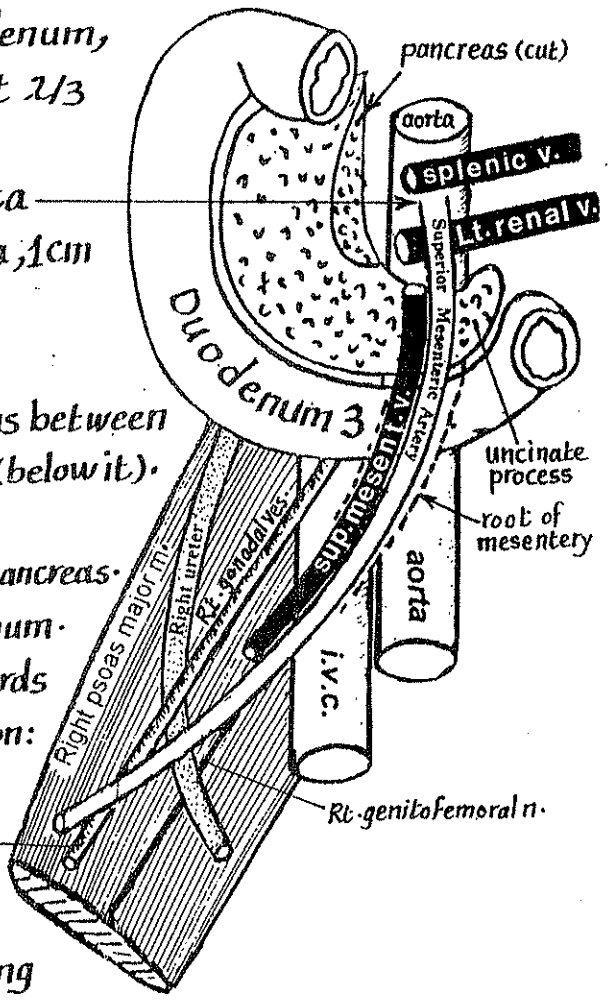
(5) Lt. terminal hepatic branch: enters the Lt lobe of the liver.

(6) Cystic artery: arises from the Rt. terminal br. It passes to the Rt. behind the common hepatic & cystic ducts to reach the gall bladder

II- superior mesenteric artery

* **It is the artery of midgut** (lower ½ of duodenum, jejunum, ileum, caecum, ascending colon & right 2/3 of transverse colon).

* **Origin**: from the front of the abdominal aorta opposite the lower border of L1 vertebra, 1cm below the origin of the coeliac trunk.



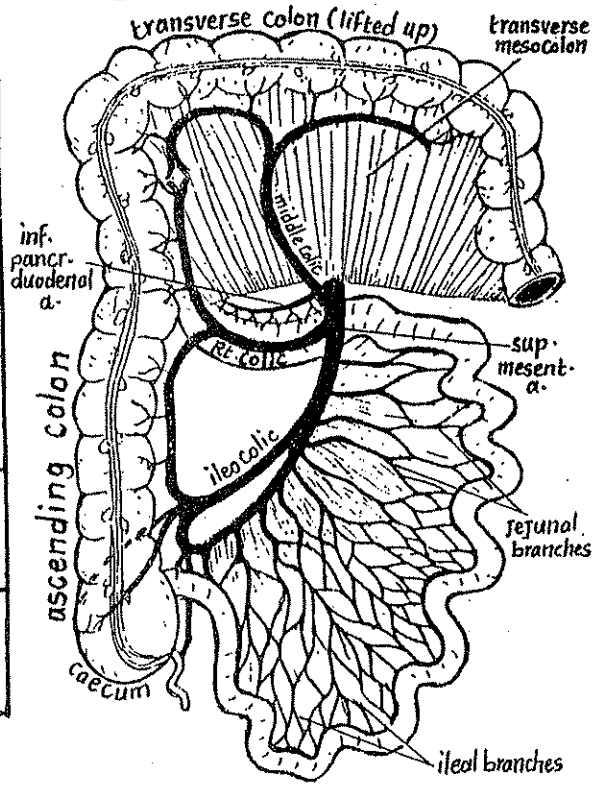
* **Course & relations:**

- At its origin it lies behind the body of pancreas between 2 veins: splenic vein (above it) & Lt. renal vein (below it).
- It descends first infront of (a) left renal vein
  (b) uncinate process of pancreas.
  (c) 3rd part of duodenum.
- then it enters the root of mesentery & runs downwards & to the Rt., crossing the following stuctures in succession:
  (1) abdominal aorta (2) I.V.C. (3) Rt. psoas major m.
  (4) Rt. genitofemoral n. (5) Rt. ureter (6) Rt. gonadal a.
- the sup. mesenteric vein lies along its right side.

* **Termination**: in the Rt. iliac fossa, by anastomosing with the ileal branches of the ileo colic artery.

* **Branches:**

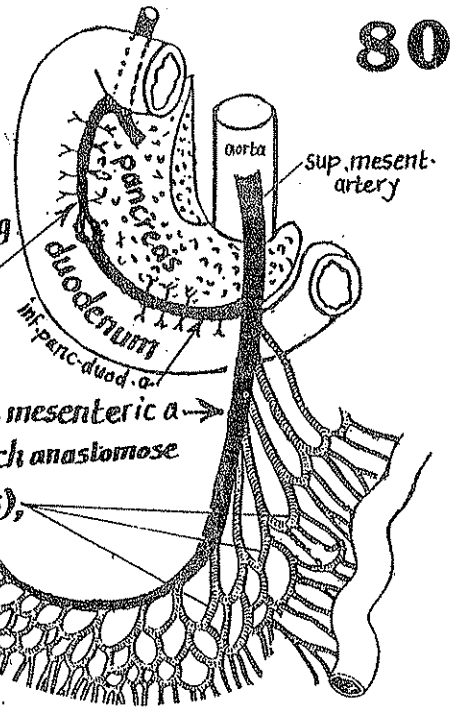
	Branch	area of midgut supplied
1-	inf. pancreatico-duodenal a.	lower ½ of duodenum + part of the head of pancreas.
2-	Jejunal and ileal branches	jejunum + ileum (except its terminal part).
3-	Ileo-colic a.	terminal part of ileum, caecum, appendix & lower ⅓ of ascend. colon.
4-	Rt. colic a.	upper 2/3 of ascending colon + Rt. colic flexure
5-	Middle colic a.	proximal (right) 2/3 of transverse colon



For details of the branches see page 80.

(1) Inf. pancreaticoduodenal a.:

- arises from sup. mesenteric a. as it crosses the uncinate process of the pancreas.
- ascends between the head of pancreas & duodenum (supplying both) & ends by anastomosing with sup. pancreaticoduod. a.



(2) Jejunal & ileal branches:

- are 12-15 branches which arise from the convex side of sup. mesenteric a.
- they pass through the mesentery, dividing into branches which anastomose with each other forming a series of arterial arches (arcades), the terminal ones give straight end arteries (Vasa recta) which supply the jejunum & ileum (except its terimina part).

(3) Ileocolic artery:

- arises from the Rt. side of sup. mesenteric a. a little below the origin of right colic artery.
- it runs downwards & to the Rt. on the post. abdominal wall giving the following branches:

(a) ileal branches: to the terminal part of ileum & anastomose with the termination of sup. mesenteric a.
(b) ant. caecal br. to the front of Caecum.
(c) post. " " " " back " ".
(d) appendicular a.: passing behind the terminal part of ileum & reaching the appendix through its mesentery.
(e) ascending br. to lower 1/3 of ascending colon, anastomosing with the descending branch of the right colic a.

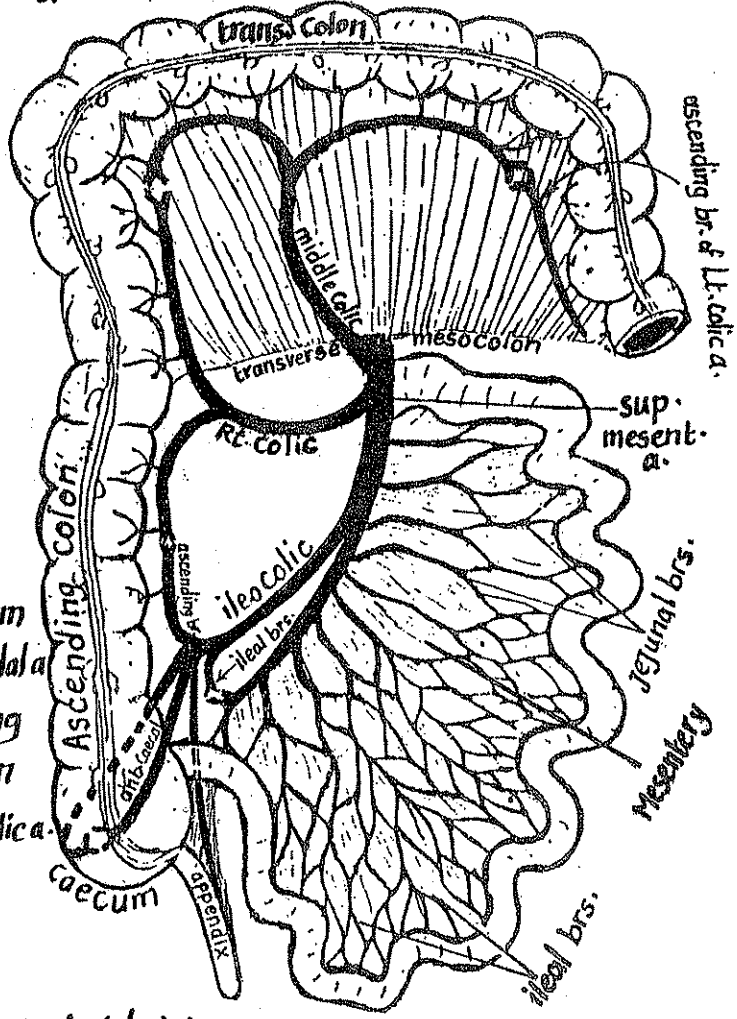
(4) Right colic artery:

- arises from the Rt. side of sup. mesent. a a little below the middle colic a.
- runs to the Rt. behind the parietal peritoneum crossing the Rt. psoas, Rt. ureter & Rt. gonadal a.
- it divides into 2 brs.: ascending & descending which supply the upper 2/3 of ascending colon & anastomose with the ascending br. of Rt. colic a. & the Rt. br. of middle colic a.

(5) Middle Colic artery:

- arises just below the pancreas.
- it enters the transverse mesocolon where it divides into:

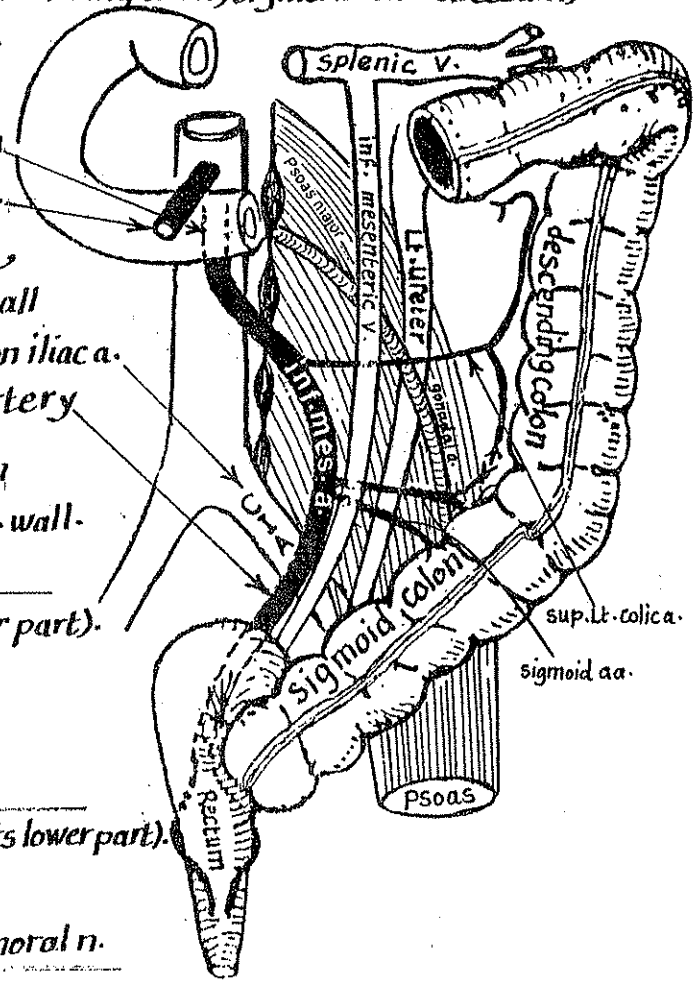
(a) Rt. br. anastomosing with the ascending br. of Rt. colic a. } both branches supply the
(b) Lt. br. " " " " " " Lt. colic a. } Rt. 2/3 of transverse colon.



III- inferior mesenteric artery

* It is the artery of hindgut (Lt. 1/3 of tr. colon, descending colon, sigmoid colon & rectum).
* **Origin**: From the front of abd. aorta opposite L3.
* **Course**:

(1) At its origin, it lies behind 3rd part of duodenum which separates it from the superior mesenteric a.
(2) it descends, with a slight curve convex to the left, behind the peritoneum of the post. abdominal wall
(3) then it enters the pelvis by crossing the Lt. common iliac a. where it ends by becoming the superior rectal artery



* **Relations**:

(A) **Anteriorly**:
- (1) 3rd part of the duodenum
- (2) peritoneum of the post. abd. wall.
- (3) Coils of small intestine

(B) **Posteriorly**:
- (1) abdominal aorta (in its upper part).
- (2) Lt. sympathetic chain.
- (3) Lt. psoas major muscle.
- (4) Lt. common iliac artery.

(C) **on Lt. side**:
- (1) superior mesenteric V. (in its lower part).
- (2) Lt. ureter
- (3) Lt. gonadal a. & Lt. genitofemoral n.

(D) **on Rt. side**: lower part of abdominal aorta.

* **Branches**:

1-Superior Lt. colic a.:
- passes to the Lt. behind peritoneum of post. abd. wall crossing: (a) Lt. poas major m. (b) Lt. ureter (c) Lt. gonadal a.
- It divides into 2 brs.: (a) ascending br.: ascends to anastomose with Lt. br. of middle colic a.
  (b) descending br.: anastomoses with the uppermost sigmoid artery.
- it supplies: Lt. 1/3 of transverse colon & the upper part of the descending colon.

2-Inferior Lt. Colic (Sigmoid) arteries: 2-3 brs.
- pass to the Lt. behind peritoneum of post. abd. wall crossing: (a) Lt. psoas major (b) Lt. ureter (c) Lt. gonadal a.
- they supply the lower part of the descending colon + the sigmoid colon.
- they anastomose with the descending br. of sup. Lt. colic a. & with the sup. rectal a.

3-Superior rectal a.: is the continuation of inf. mesenteric a. (see pelvis for details).

N.B: the arteries of the large intestine anastomose together forming the Marginal artery (see p. 57).

Anastomoses between the 3 arteries of the gut:

(1) sup. pancreaticoduodenal (caeliac) anastomoses with inf. pancreaticoduodenal a. (sup. mesent.).
(2) middle colic a. (of sup. mesenteric a.) " " sup. left colic a. (of inf. mesenteric a.)

VEINS OF THE GUT

* The veins which drain the stomach, small intestine, large intestine as well as the spleen, pancreas & gall bladder drain into the Portal vein & constitute the portal circulation.

PORTAL VEIN

(remember no. 2 about portal v.)

* **Origin**: it is formed behind the neck of pancreas at the level of L 2 by the union of 2 veins: (a) Splenic v. (b) Sup. mesenteric v.

* **Termination**: in the porta hepatis by dividing into 2 branches (Rt. & Lt.).

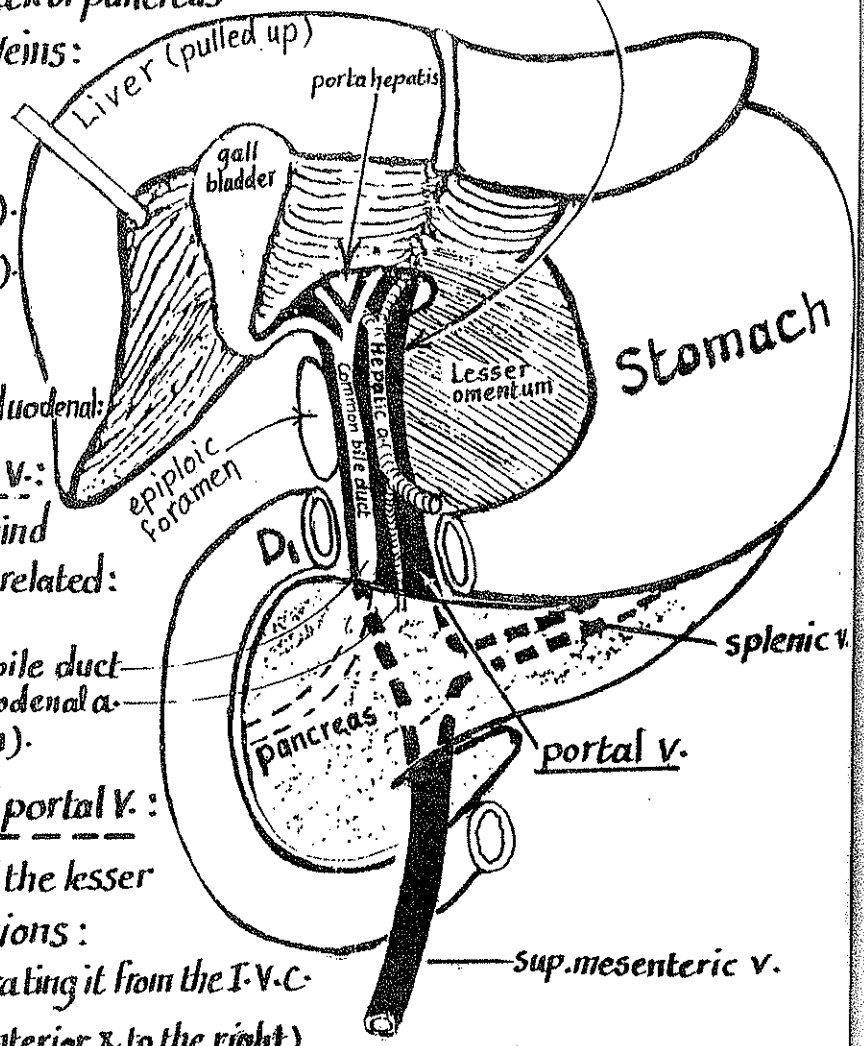
* **Length**: $2\frac{1}{2} - 3\frac{1}{2}$ inches (about 8 cm).

* **Course & relations**:

it has 2 parts: retroduodenal & supraduodenal:

(1) **The Retroduodenal part of portal v.**:
ascends upwards & to the right behind the 2nd of 1st part of duodenum & is related:
- posteriorly: to the I.V.C
- anteriorly: to → common bile duct, → gastroduodenal a.
(separating it from the duodenum).

(2) **The Supraduodenal part of portal v.**:
ascends in the right free margin of the lesser omentum, having the following relations:
- Posteriorly: epiploic foramen separating it from the I.V.C.
- anteriorly: (a) Common bile duct (anterior & to the right)
(b) hepatic artery (anterior & to the left).



* **Terminal branches of the portal v.**:
on reaching the porta hepatis, the portal v. divides into: Rt. terminal br. (shorter & wider), Lt. terminal br. (longer & narrower).
which enter the corresponding lobes of the liver having the following relations:
- Anteriorly: - the Rt. & Lt. hepatic ducts (most anterior).
- the Rt. & Lt. branches of the hepatic a. (in the middle).
- posteriorly: the terminal part of the portal v. & its 2 branches are related to the I.V.C. but separated from it by the caudate process of the caudate lobe.

N.B: 2 ligaments are attached to the Lt. branch of the portal v.:
(1) ligamentum teres (obliterated Lt. umbilical v. of the foetus) which reaches the umbilicus.
(2) ligamentum venosum (» ductus venosus » » ») » » » I.V.C.

Tributaries of portal vein

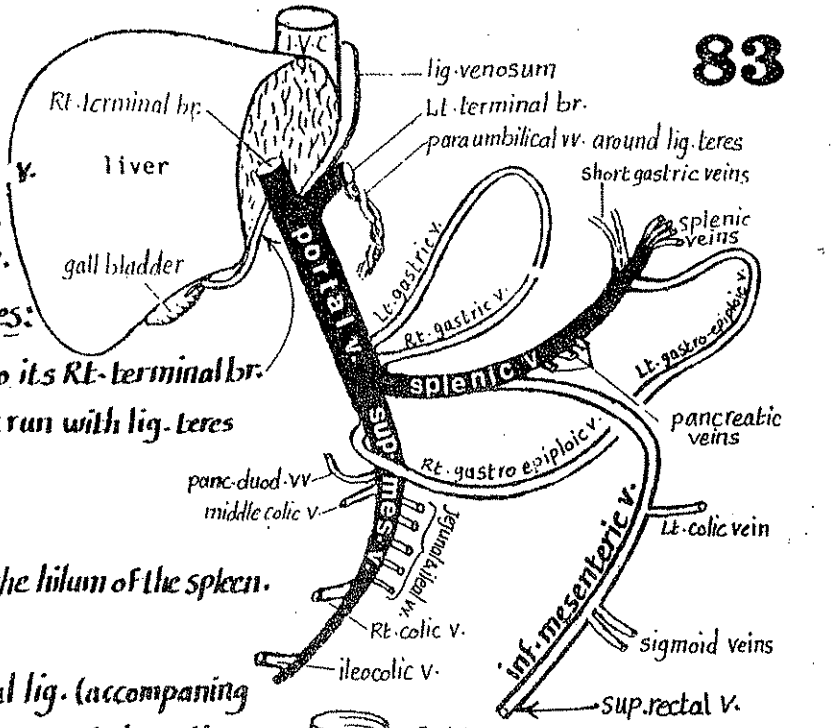
(A) 2 main tributaries: splenic v. + sup. mesenteric v.

(B) 2 veins from stomach: Lt. gastric v. + Rt. gastric v.

(C) 2 veins drain into its terminal branches:

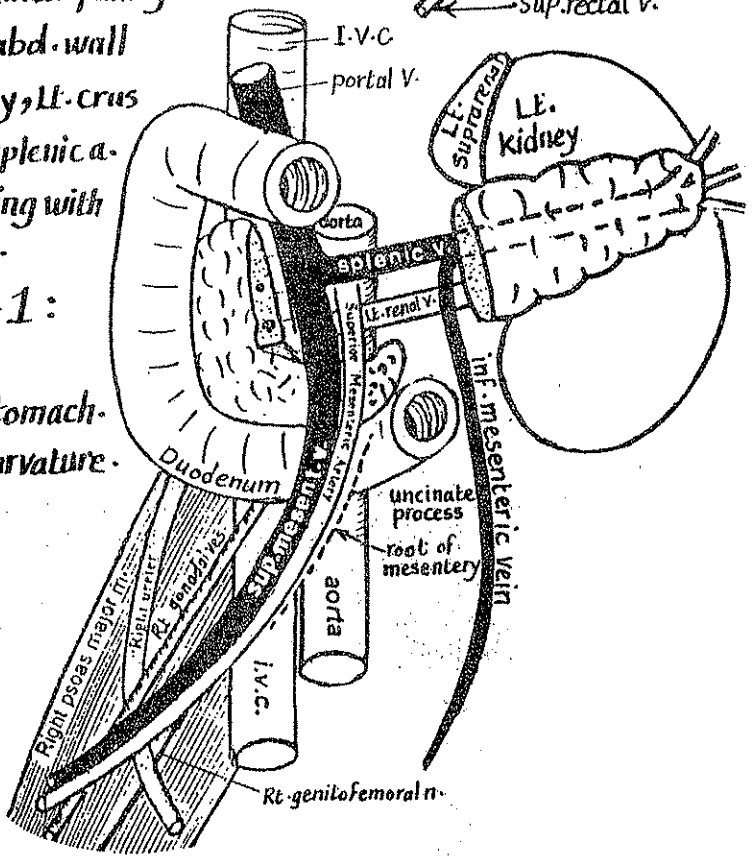
(a) cystic v. (from the gall bladder): drain into its Rt. terminal br.

(b) para umbilical vv. (from ant. abd. wall): run with lig. teres to end in the Lt. terminal branch.



* Splenic Vein:

- **Begins** by the union of 5-6 splenic veins at the hilum of the spleen.
- **Course & relations:**
  - it passes to the right through the lieno renal lig. (accompaning splenic a. & tail of pancreas) then across the post. abd. wall behind the body of pancreas & infront of Lt. kidney, Lt. crus of diaphragm, Lt. symp. chain & aorta, lying below splenic a.
- **It ends:** behind the neck of pancreas by uniting with the sup. mesenteric v. to form the portal vein.
- **Tributaries:** like branches of splenic artery + 1:
  1) 5-6 splenic veins: from the spleen.
  2) short gastric veins: from the fundus of the stomach.
  3) Lt. gastro-epiploic v.: from Lt. part of greater curvature.
  (d) pancreatic veins: from the pancreas +
  (e) inferior mesenteric V.: See page 84.



* Superior mesenteric vein:

- **Begins:** in the lower end of root of mesentery.
- **Course & relations:**
  it ascends in the root of mesentery on the right side of sup. mesenteric a, having the same relations i.e crossing the following structures: Rt. psoas major, Rt. genitofemoral n., Rt. ureter, Rt. gonadal a., I.V.C, Aorta, 3rd part of duodenum & uncinate process of pancreas.
- **Ends:** behind the neck of pancreas by joining the splenic v. to form the portal v.
- **Tributaries:** Correspond to the branches of sup. mesenteric artery + 1:

(1) pancreaticoduodenal veins (2) jejunal & ileal veins (3) ileocolic vein.
(4) right colic vein (4) middle colic v. + (5) Rt. gastro-epiploic vein

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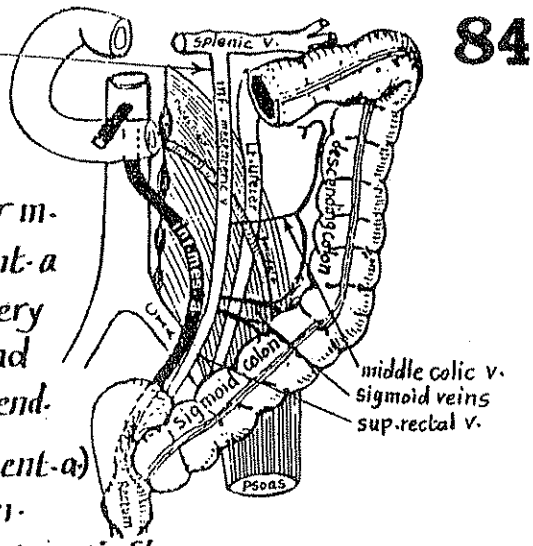
N.B: the splenic vein is straight, unlike the splenic artery which is tortuous.

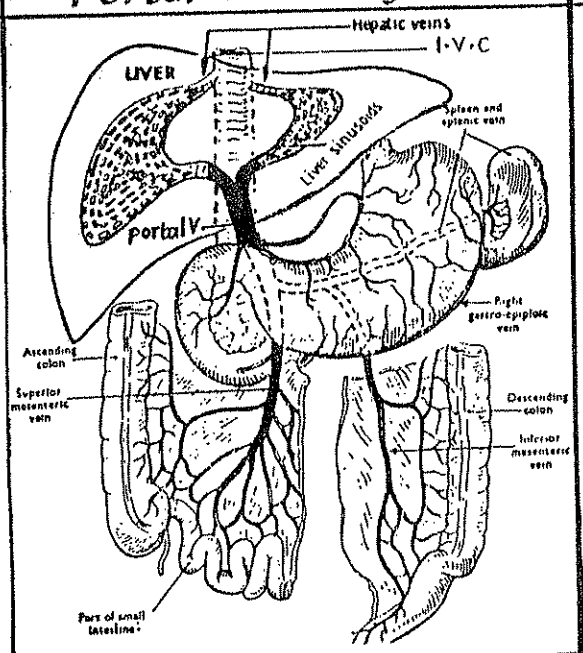
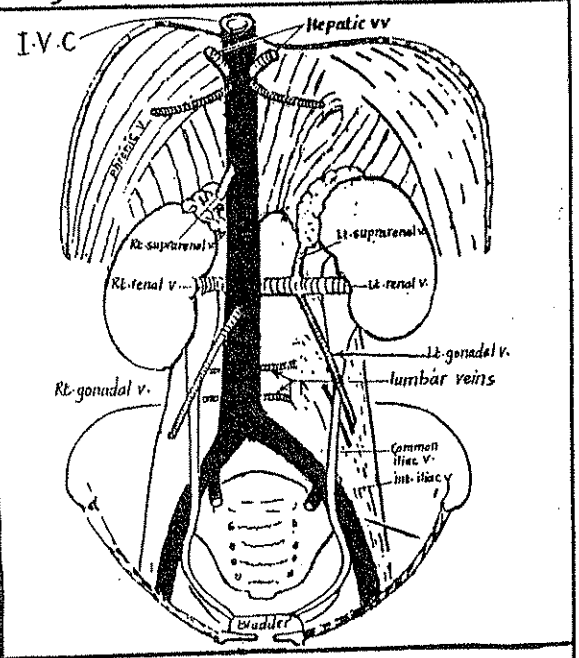
Inferior mesenteric vein:



* **Begins**: infront of the Lt. common iliac artery as a continuation of the superior rectal vein.
* **Course & relations**:
  - it ascends retroperitoneally, infront of Lt. psoas major m. medial & parallel to the Lt. ureter but lateral to inf. mesent. a
  - its upper part becomes widely separated from the artery & passes behind the duodenojejenal flexure then behind the body of pancreas to join the splenic v. near its Rt. end.
* **Tributaries**: (Correspond to the branches of inf mesent. a)
  (1) sigmoid veins: from the sigmoid colon.
  (2) Lt. Colic vein: from descending colon & Lt. colic flexure.

PORTAL CIRCULATION

* It is concerned with the venous drainge of the G.I.T, spleen, pancreas & gall bladder & carrying the venous return to the liver via the portal v.
* It differs from the systemic venous circulation in the following:

	Portal venous system	Systemic venous system
		
draining veins	portal vein & its tributaries	Inf. vena cava & its tributaries
organs drained	the gastrointestinal tract (except liver)	the remaining abdominal & pelvic organs, the abdominal walls + the liver.
Beginning & termination	begins by network of capillaries in the submucosa of the alimentary tract ends by sinusoidal capillaries in the liver i.e it has 2 sets of capillaries	begins by capillaries in the walls of the drained abdominal & pelvic organs. ends in the Rt. atrium of the heart. i.e it has one set of capillaries.
quality of blood	deoxygenated blood loaded with products of digestion of food (not detoxified	deoxygenated blood with no products of digestion (detoxified in the liver.

PORTO-SYSTEMIC ANASTOMOSIS

* **Definition**: it is the anastomosis between the tributaries of the portal vein & those of the systemic veins (inferior vena cava & superior vena cava).
* **Significance**: it opens in case of obstruction of the branches of the portal V. inside the liver in cases of liver cirrhosis (fibrosis) to allow collateral circulation for the portal blood flow.

* Sites of porto Systemic anastomosis:

(1) **At the lower end of oesophagus**: between:
- (a) oesophageal tributaries of Lt. gastric V. (portal)
- (b) oesophageal tributaris of azygos V. (systemic)

opening of this anastomosis (in portal hypertension) leads to oesophageal varices (دوالى المرئ).

(2) **At the anal Canal**: between:
- (a) sup. rectal V. (portal).
- (b) middle & inf. rectal VV. (systemic).

opening of this anastomosis leads to internal piles (بواسير داخليه).

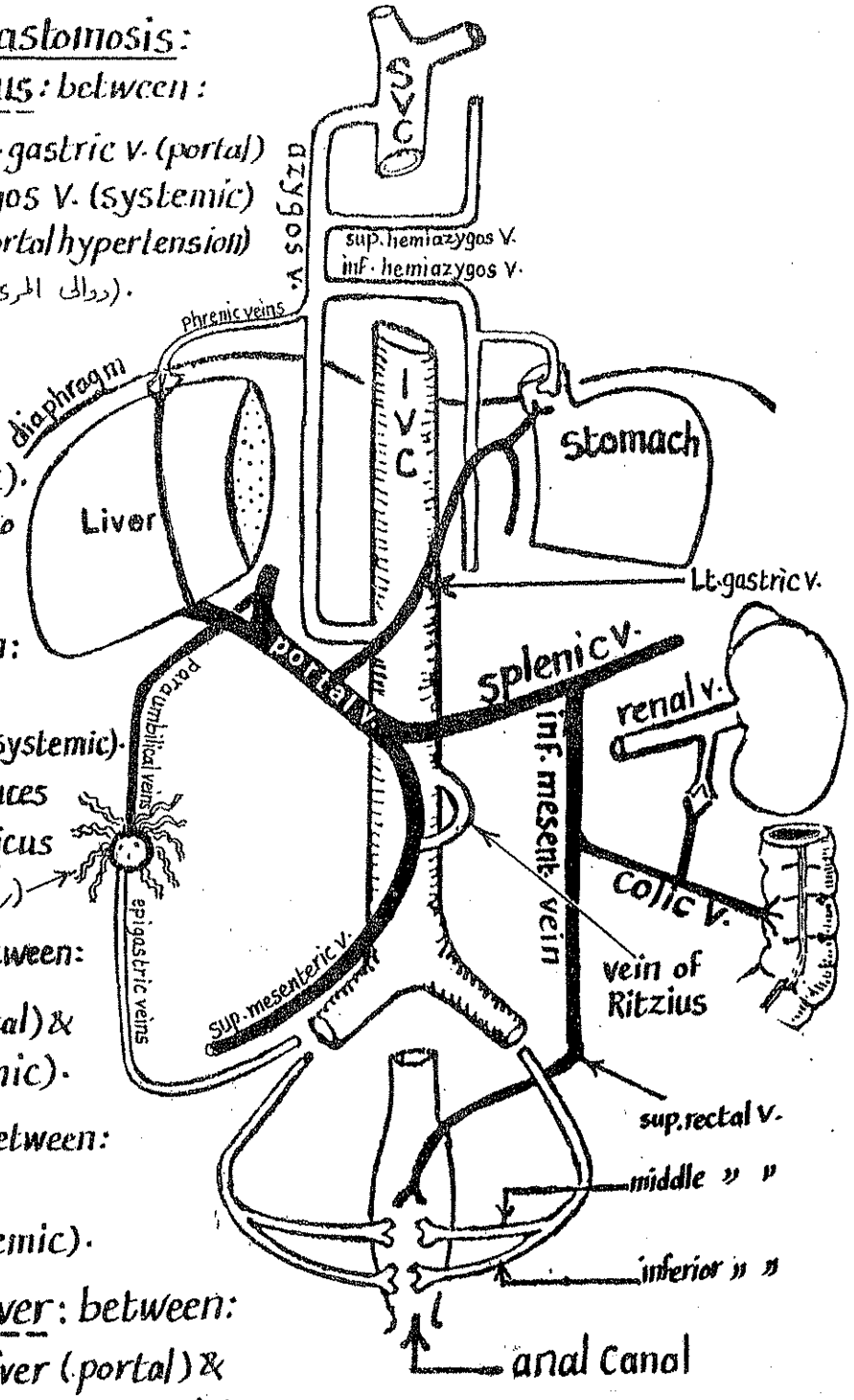
(3) **Around the umbilicus**: between:
- (a) para-umbilical veins (portal).
- (b) epigastric veins of ant-abd. wall (systemic).

openining of this anastomosis produces dilated radiating veins around umbilicus called caput medusae (رأس الحمرة).

(4) **Vein of Ritzius**: Comecls between:
- (a) Superior mesenteric vein (portal) &
- (b) inferior Vena Cava (systemic).

(5) **On the posterior abd-wall**: between:
- (a) Colic veins (portal).
- (b) renal & lumbar veins (systemic).

(6) **At the bare area of the liver**: between:
- (a) twigs from the veins of the liver (portal) &
- (b) phrenic veins of the diaphragm (systemic).

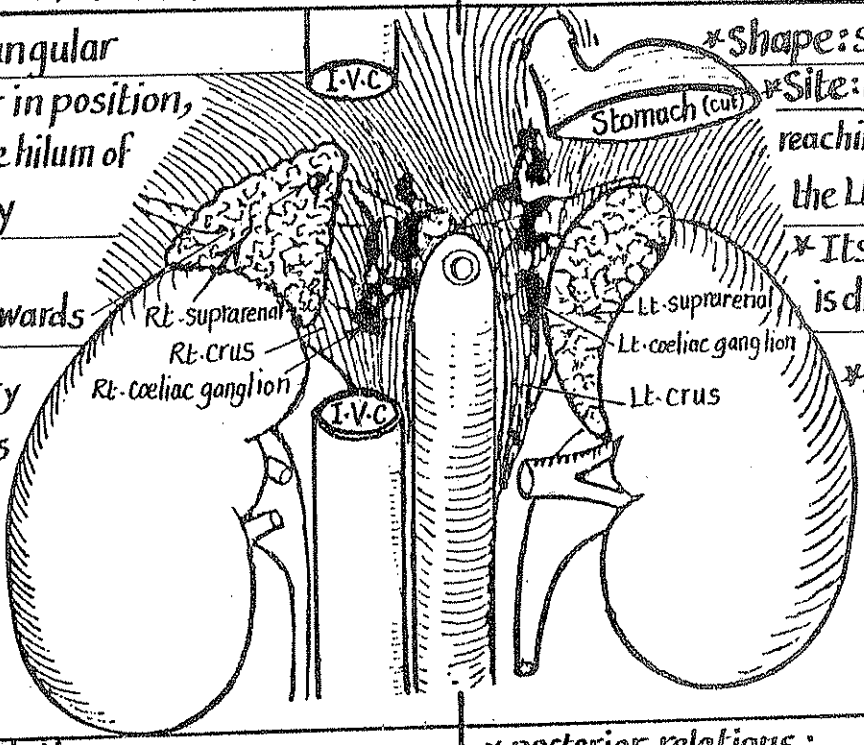


* **Applied anatomy**: the normal portal blood pressure is 5-15 mm Hg. If it increases above 40 mm Hg. the condition is called Portal hypertension caused mainly by liver cirrhosis.

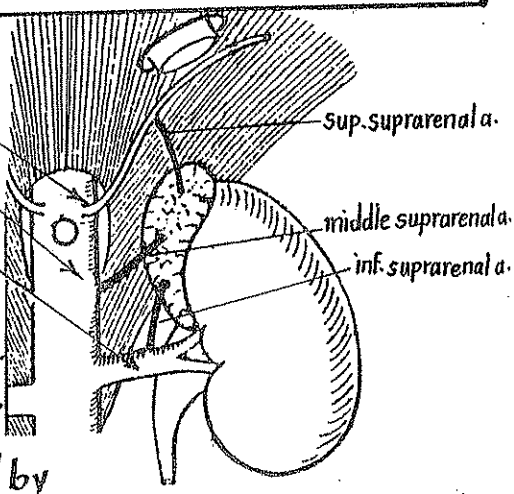
Suprarenal glands

* They are 2 small endocrine glands (each one is about 5 gm), closely related to the upper poles of the Rt. & Lt. kidneys.

Rt. Suprarenal Gland	Lt. Suprarenal Gland
* Shape: triangular	* Shape: semilunar
* Site: higher in position, not reaching the hilum of the Rt. kidney	* Site: lower in position, reaching the hilum of the Lt. kidney
* Its hilum: is directed upwards	* Its hilum: is directed downwards
* Is Vein: is very short and ends in the I.V.C	* Its Vein: is longer and opens into the Lt. renal V.
* posterior relations: (a) Rt crus of diaphragm (b) upper part of ant. surface of the right kidney	* posterior relations: (a) Lt. crus of diaphragm. (b) upper part of ant. surface of the left kidney.
* Medial relations: (a) Rt. Coeliac ganglion. (b) Rt. inferior phrenic artery.	* Medial relations: (a) Lt. coeliac ganglion. (b) Lt. inferior phrenic artery.
* Anterior relations: (a) bare area of the liver (laterally). (b) I. V. C. (medially).	* Anterior relations: (a) Stomach & lesser sac of peritoneum (above). (b) body of pancreas & splenic artery (below).



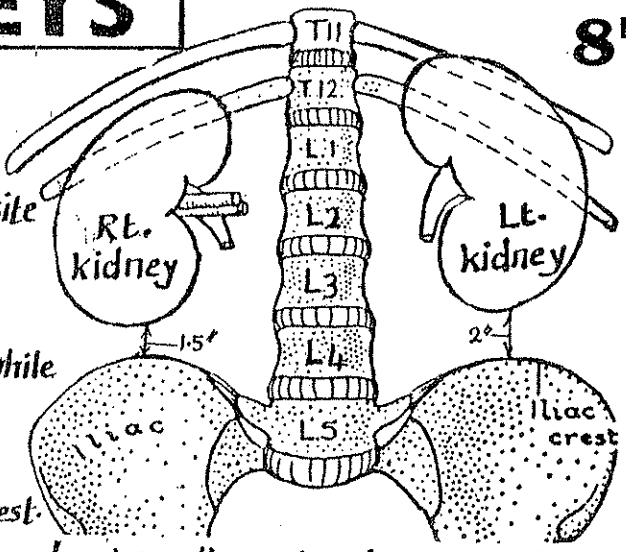
* Arterial Supply: each gland is supplied by 3 arteries:
  (1) Superior suprarenal a.: arises from inferior phrenic a.
  (2) middle " " " : arises from abdominal aorta
  (3) inferior " " " : arises from the renal artery



* Venous drainage: one vein emerges from each gland:
  - the Rt. suprarenal V. ends in the I.V.C (like Rt. gonadal V.).
  - the Lt. suprarenal V. ends in Lt. renal V. (" Lt. " ").

* Nerve Supply: suprarenal medulla is richly supplied by preganglionic Sympathetic fibres ending on its chromaffin cells which are homologus with postganglionic symp. neurones.

KIDNEYS



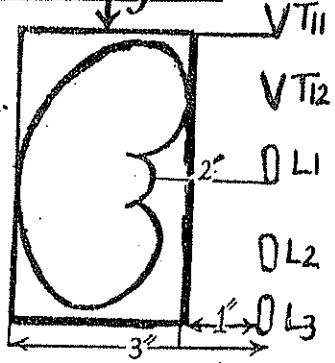
*Size: 12 cm long, 6 cm wide & 3 cm thick.

*Site: they are retroperitoneal organs lying on the upper part of post. abdominal wall opposite the last thoracic & upper 3 lumbar vertebrae.

NB1- the Rt. kidney is ½ inch lower than the Lt.:
- its upper end reaches the 11th intercostal space while the Lt. kidney reaches the 11th rib.
- its lower end is 1½ inches from the iliac crest. while that of the Lt. kidney is 2" from the iliac crest.

2- the long axis of each kidney is directed downwards & laterally so that the upper poles of the 2 kidneys are closer to the median plane than their lower poles.

*Surface anatomy of the kidney from behind: Morris parallelogram:



on the back of the patient draw the follollowing lines:
- 2 vertical lines: 1 inch & 3 inches apart from the median plane.
- 2 horizontal lines: at the level of T11 & L3 spines.
- the centre of the hilum lies opposite the lower border of L1 spine (in the transpyloic plane) & 2" from median plane.

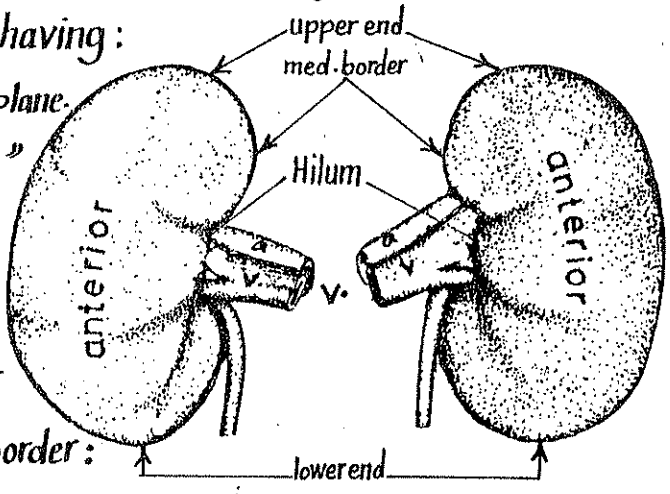
*Shape & general features of the kidney:

the kidney is a reddish brown bean-shaped organ having:

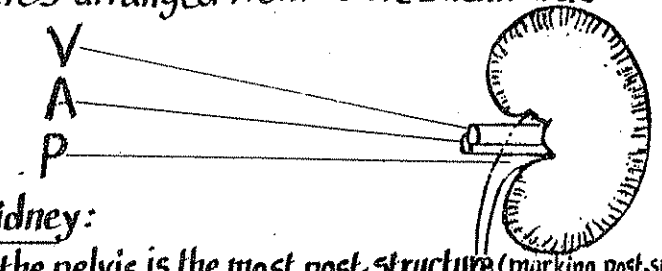
2 Ends: upper end: broader & 1" from median plane.
lower end: rounded & 2" " " "

2 Borders: med.: concave & presenting the hilum.
lat.: convex.

2 Surfaces: ant.: irregular & related to abd. organs.
post: flat & applied to the post. abd. wall.



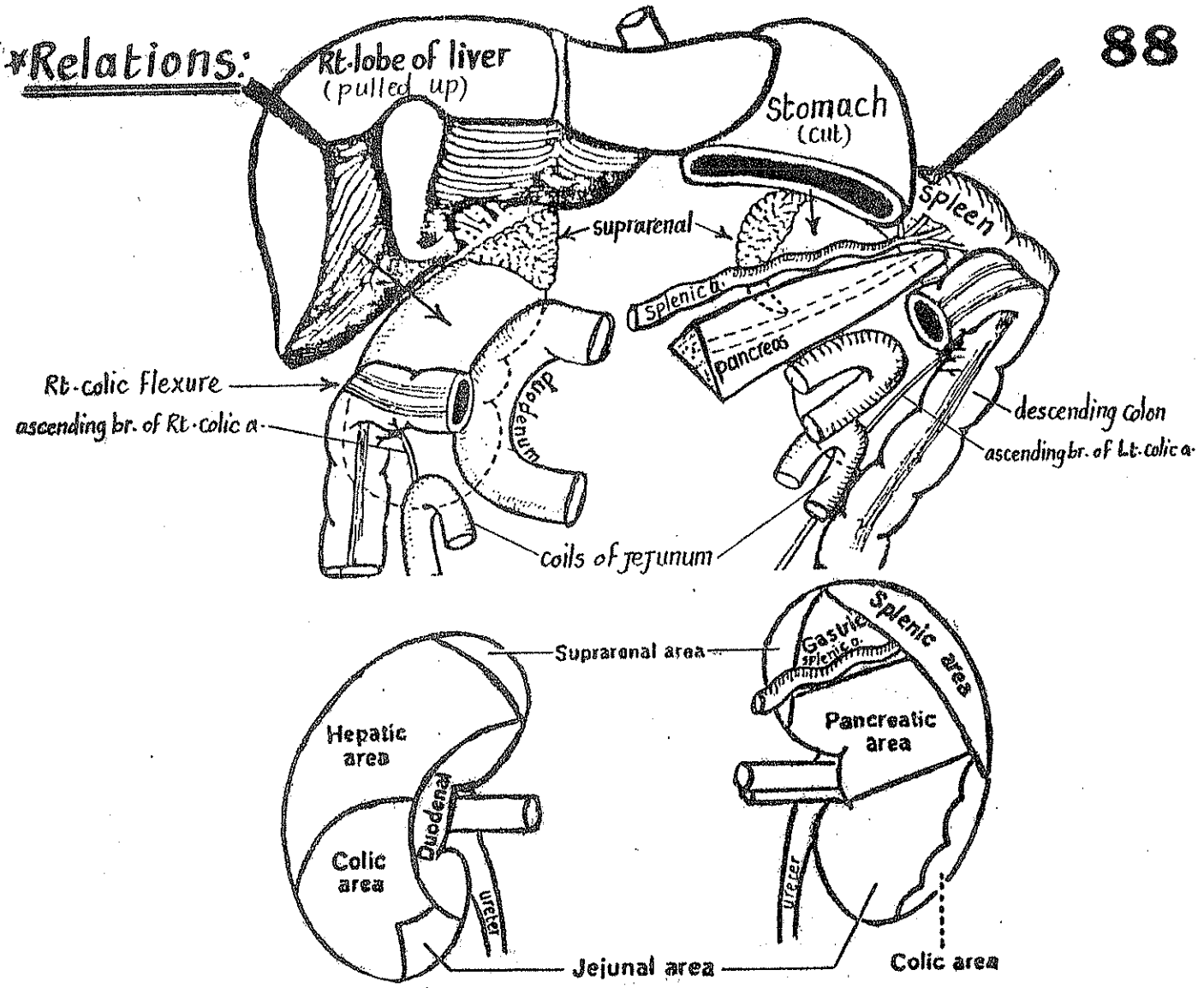
*Hilum of the kidney: lies in the middle of med. border:
- it leads to a wide space inside the kidney called renal sinus.
- it gives passage to the following structures arranged from before backwards:
  (1) Renal Vein: most anteriorly.
  (2) Renal Artery: in the middle
  (3) Pelvis of the ureter: most posteriorly



*How to identify the Rt. Kidney from the Lt. kidney:

1- the med. border is identified by the hilum (2) the pelvis is the most post. structure (marking post. surface).
3- the ureter projects downwards marking the lower pole. Now put the kidney in the anatomical position.

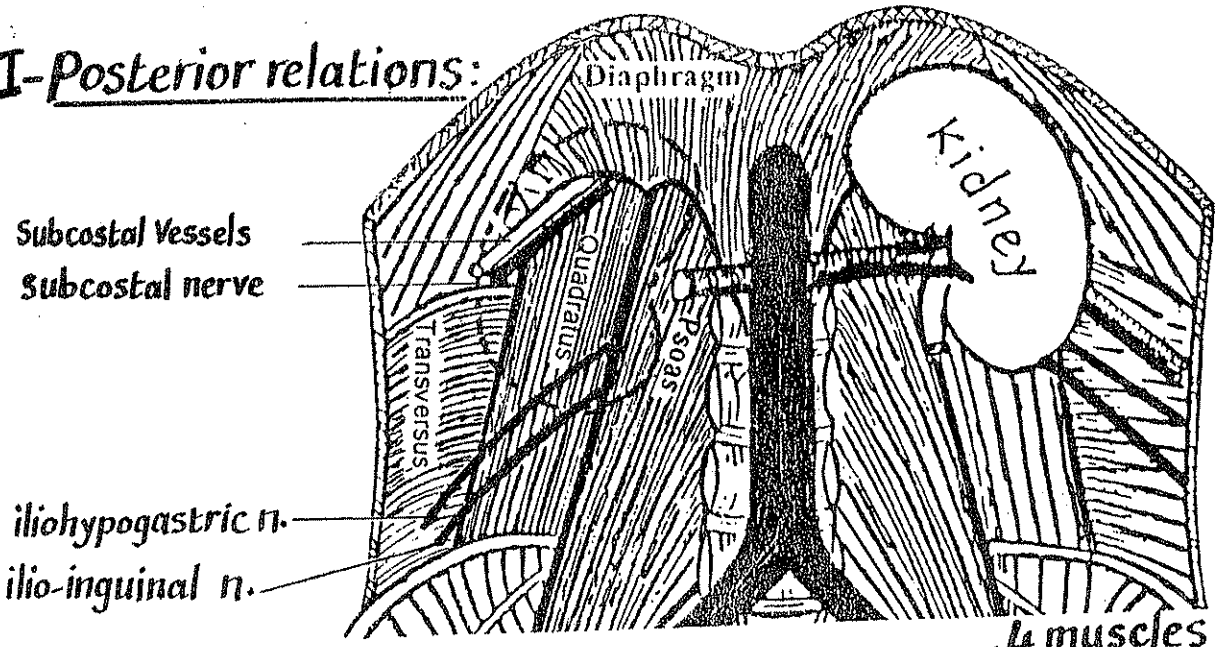
*Relations:



I-Anterior relations: the ant. relations of the 2 kidney are different (but comparable):

Ant. relations of the Rt. kidney	Ant. relations of the Lt. kidney
(1) Rt. suprarenal gland: along the ant. & med. aspect of the upper pole	(1) Lt. suprarenal gland: along upper end & upper part of the med. border
(2) 2nd part of duodenum: along the hilum & area adjoining it.	(2) Stomach: related to triangular area in the upper part of the ant. surface.
(3) Rt. lobe of the liver: related to the area between the suprarenal, duodenal & colic areas.	(3) Spleen: related to the upper 2/3 of the lat. part of the anterior surface
(4) Rt. Colic flexure: infront of the lat. part of the lower 1/3 of the ant. surface.	(4) descending Colon: infront of lower 1/3 of lat. part of the ant. surface.
(5) Coils of jejunum: infront of the lower med. part.	(5) Coils of jejunum: infront of the lower med. part
(6) Ascending br. of Rt. Colic a.: infront of lower end.	(6) Ascending br. of Lt. Colic a.: infront of lower end
	(7) lat. part of body of pancreas (with splenic a. above it & splenic v. behind it): infront of middle part of ant. surface.

II- Posterior relations:



* The posterior relations of the 2 Kidneys are similar & include < 4 muscles / 4 neurovascular structures

A- The 4 muscles: (D.P.Q.T):

(1) Diaphragm (& the med. & lat. arcuate ligs.): behind the upper part of the kidney.

- The diaphragm separates the kidney from the costo-diaphragmatic recess of pleura & the ribs 11 & 12 (on the Lt. side) or the 12th rib (on the Rt. side).

N.B: if the vertebro costal Δ of the diaphragm is wide (fleshy fibres of diaphragm are absent) the kidney will be directly related to the pleura (commoner on the Lt. side).

(2) Psoas major (and minor if present): behind the medial border & hilum of the kidney

(3) Quadratus lumborum m.: behind intermediate vertical part of post. surface.

(4) Transversus abdominis m.: behind a vertical strip close to the lat. border of the kidney

B- The 4 neurovascular structures: include

(1) Subcostal vessels.
(2) Subcostal nerve.
(3) iliohypogastric nerve.
(4) ilioinguinal nerve.

They intervene between the kidney & the quadratus lumborum & transversus abdominis.

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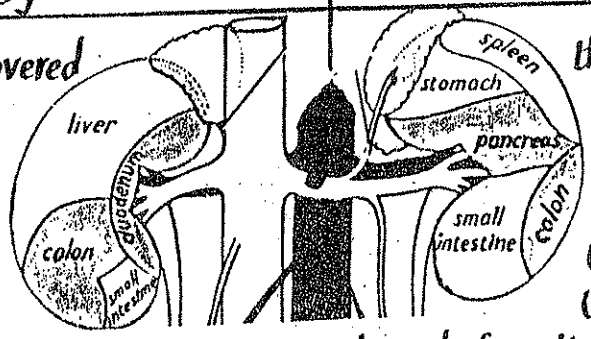
* Peritoneal relations (covering) of the kidneys:

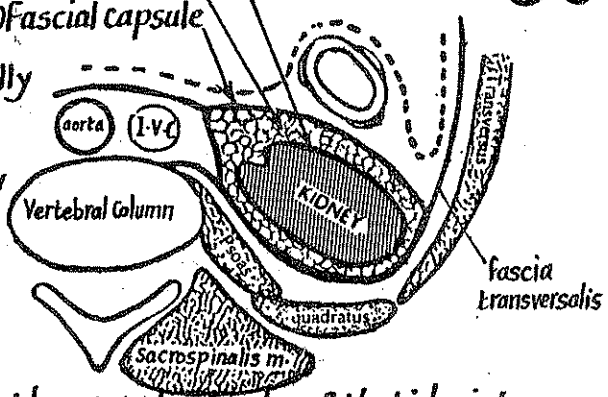
Right Kidney	Left Kidney
The ant. surface is covered by peritoneum only in the areas related to: (1) the liver. (2) small intestine.	the ant. surface is covered by peritoneum only in the areas related to (1) spleen (2) Stomach (3) small intestine



* The other areas of the ant. surface are devoid of peritoneal covering.

* Capsules (coverings) of the kidney: 3F:

(1) Fibrous capsule
(2) Fatty capsule
(3) Fascial capsule



(1) **Fibrous capsule**: is the inner true capsule that invests the kidney & extends to the renal sinus. Normally it is not adherent i.e it can be stripped off easily.

(2) **Fatty Capsule** (peri-renal fat): surrounds the kidney & suprarenal gland. Rapid depletion of this fat leads to ptosis (drop) of the kidney (سقوط الكلية).

(3) **Fascial capsule** (Zuker candle fascia):

- it is derived from the fascia transversalis which divides at the **lat. border** of the kidey into:
  - (a) **ant. layer**: passes infront of the kidney & fuses with the C.T infront of aorta & I.V.C.
  - (b) **post. layer**: passes behind the kidney & fuses with the vertebral column.

N.B: superiorly, the 2 layers fuse above the suprarenal gland but below the 2 layers remain separate.

---

* Stability of the kidney: the kidney is fixed in position by:

(1) its **position** in the depth of the paravertebral gutter.
(2) its **coverings** of fatty & fascial capsules.
(3) its **vascular pedicle** i.e the renal vessels connecting the kidney to the major vessels (aorta & IVC).
(4) the **positive intra-abdominal pressure** causing apposition of neighbouring viscera to the kidney.

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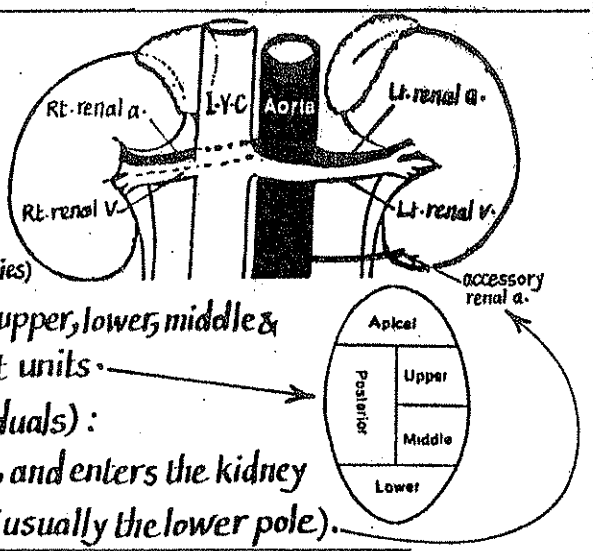
* Arterial Supply of the kidney:



(1) **Renal artery**: arises from the aorta at the level of L2:
- (a) the Lt. renal a. is short & passes behind the Lt. renal V.
- (b) the Rt renal a. is long & passes behind I.V.C & Rt. renal V.

Each renal artery divides into 5 segmental brs. (end arteries) which supply 5 pyramidal segments of the kidney (apical, upper, lower, middle & posterior segments) which are considered independent units.

(2) **Accessory renal artery** (present in 30% only of individuals): it arises from the aorta, runs parallel to the renal artery, and enters the kidney either at the hilum or at one of the 2 poles of the kidney (usually the lower pole).

---

* Venous drainage: renal vein emerges from each kidney to open into the I.V.C:

(a) Rt. renal V.: is short & passes infront of the Rt. renal artery.
(b) Lt. renal V.: is long & passes infront of the abd. aorta & the Lt. renal artery.

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* Lymphatic drainage: into the para aortic L.Ns at the level of origin of renal arteries (L2).

---

* Nerve Supply: the renal plexus of nerves around renal a. (derived from the coeliac plexus) it contains sympathetic vasomotor fibres arising from T10 → L1 spinal segments

---

* Applied anatomy: kidney swellings are felt in the renal angle (the angle between the 12th rib & the lat. border of sacrospinalis m. Incisions for kidney operations should be performed one inch below the renal angle to avoid injury of the parietal pleura.

URETERS

*Shape & size : each ureter is a thick-walled retroperitoneal muscular tube 25–30 cm long & 6 mm in diameter.

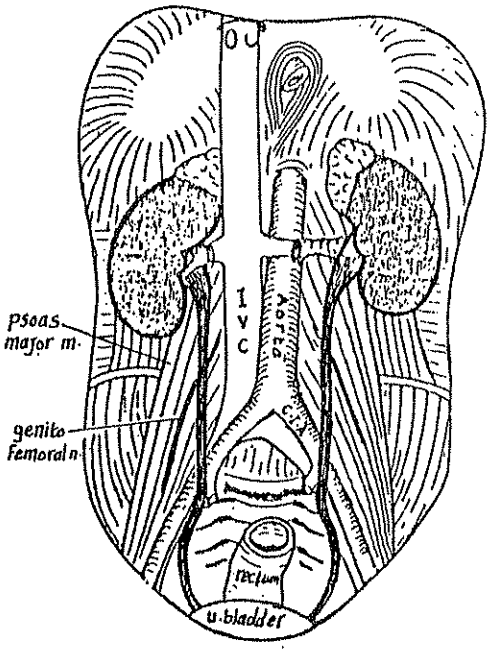
*Beginning : infront of tr. process of L1 by funnel shaped dilatation called pelvis of the ureter which is related posteriorly to psoas major muscle & is related anteriorly to renal vessels & 2nd part of duodenum (right ureter) & body of pancreas (Lt. ureter).

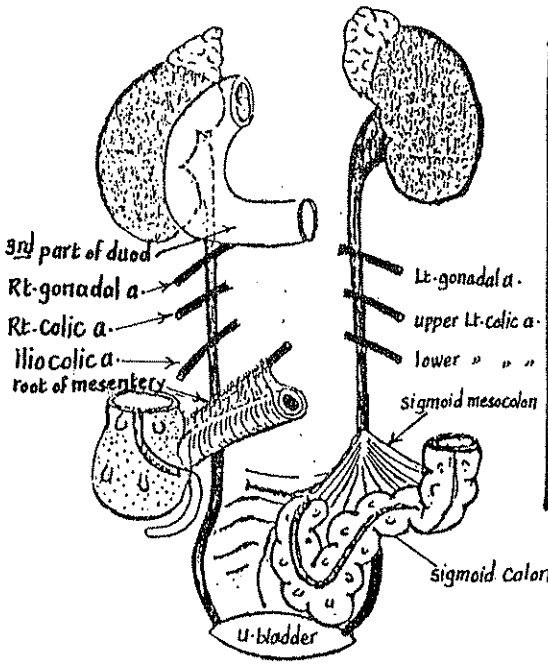
*Termination : by opening into the posterosuperior angle of the urinary bladder

*Course : is divided into 3 parts :
- (a) abdominal part : its upper ½ (on post. abd. wall).
- (b) pelvic part : its lower ½ (on lat. wall of pelvis).
- (c) intramural part : last 2 cm (inside bladder wall).

A. Abdominal Part:

POSTERIOR RELATIONS





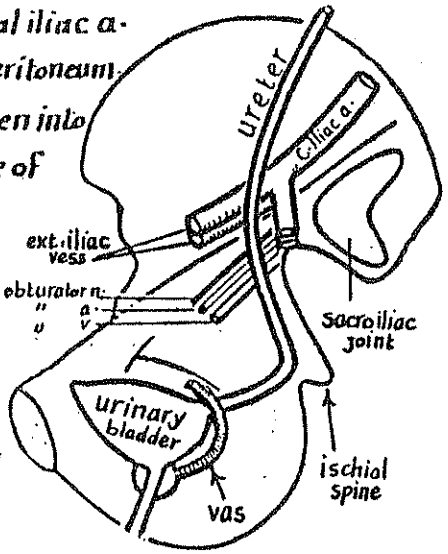
ANTERIOR RELATIONS

	Rt. ureter	Lt. ureter
Course	each ureter descends vertically behind the peritoneum of post. abd. wall opposite the tips of tr. processes of the lower 4 lumbar vertebrae.	
posterior relations	(1) med. border of psoas major (& minor) & genitofemoral n. on it. (2) tips of tr. processes of the lower 4 lumbar vertebrae (behind psoas).	
Anterior relations : parietal peritoneum +	(1) 3rd part of duodenum (2) 3 arteries : (a) Rt. gonadal a. (b) Rt. Colic a. (c) ilio colic a. (3) 3 structures related to Mesentery its root, sup. mesenteric vessels & coils of ileum	(1) 3 arteries (a) Lt. gonadal a. (b) upper Lt. colic a. (c) lower " " " (2) Sigmoid Mesocolon & coils of sigmoid Colon.
Med. relations	Inf. vena cava (I.V.C)	Inf. mesenteric vein (I.M.V.)

B. Pelvic Part:

Course & relations:

(1) it enters the pelvis by crossing infront of the bifurcation of C. iliac a. (opposite sacro-iliac joint).
(2) it runs downwards & backwards along the lower border of internal iliac a. crossing ext. iliac vess., obturator n. & vess. & covered medially by peritoneum.
(3) opposite the ischial spine, the ureter curves anteromedially to open into the postero-sup. angle of urinary bladder. Here it passes on the side of vagina in the female & is crossed by the vas deferens in the male.

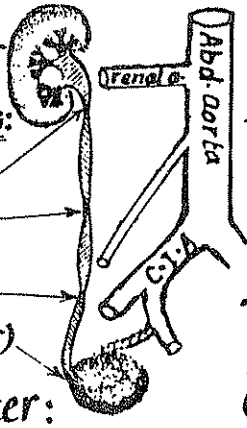


C. Intramural Part:

* The ureter joins the posterosuperior angle of urinary bladder & runs a very oblique course through its wall for 2 cm before opening. This arrangement provides a valve-like mechanism preventing regurgitation of urine from bladder to the ureter.

* Constrictions of the ureter

the ureter shows **4 normal constrictions:**
(1) at the pelvi-ureteric junction
(2) at the pelvic brim
(3) opposite the ischial spine
(4) the intramural part (inside bladder)



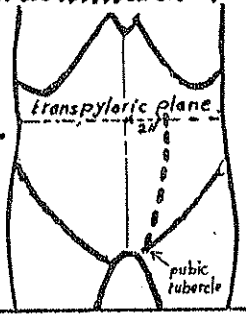
* Blood Supply of ureter

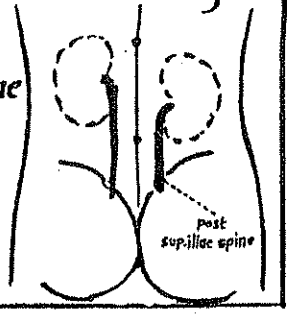
- each ureter receives a rich segmental supply from all arteries along its course:

A : Abdominal aorta.
R : Renal artery.
T : Testicular or ovarian a.
I : Inf. vesical a. (br. of int. iliac a.).
C : Common iliac artery.

* Surface anatomy of the ureter:

Anterior Surface markings of ureter	Posterior Surface markings of ureter
represented by a line drawn downwards & medially between 2 points: (1) a point on the transpyloric plane 2" from median plane. (2) a point at pubic tubercle.	draw a vertical line on the back extending between 2 points: (1) a point 2" from median plane at the level of L1 spine (2) a point at the post. sup. iliac spine





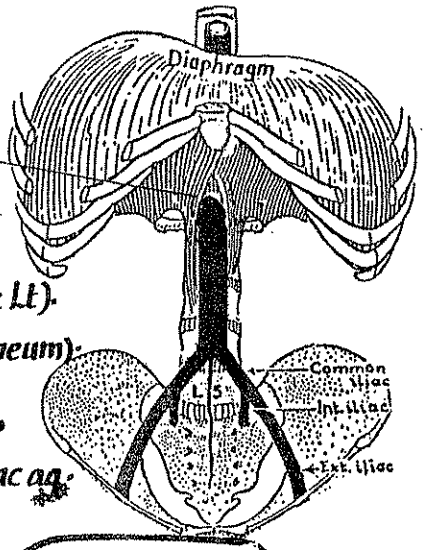
* Nerve supply of the ureter:

(a) Sympathetic fibres from T11 → L1 spinal segments
(2) parasympathetic from 2nd, 3rd & 4th sacral "
} all nerves are sensory in function.

* Applied anatomy:

(1) the ureter is identified at operation by:
  (i) it appears as thick muscular tube with longitudinal blood vessels along its wall.
  (2) it shows peristalsis & gives urine on aspiration.
(2) Ureteric pain (in renal colic) is referred to the skin of ant. abd. wall supplied by T10 to L1 spinal nerves. Pain starts in the loin & extends to the groin & external genitalia.

ABDOMINAL AORTA



*Beginning: at the aortic opening of the diaphragm (at the level of lower border of T12) as a continuation of the descending thoracic aorta.

*Course: it descends downwards (with slight inclination to the Lt.) infront of the upper 4 lumbar vertebrae (behind peritoneum).

*Termination: at the lower border of L4 vertebra, slightly to the Lt. of median plane by dividing into 2 common iliac aa.

Relations

A- **Anteriorly**: From above downwards, it is related to:

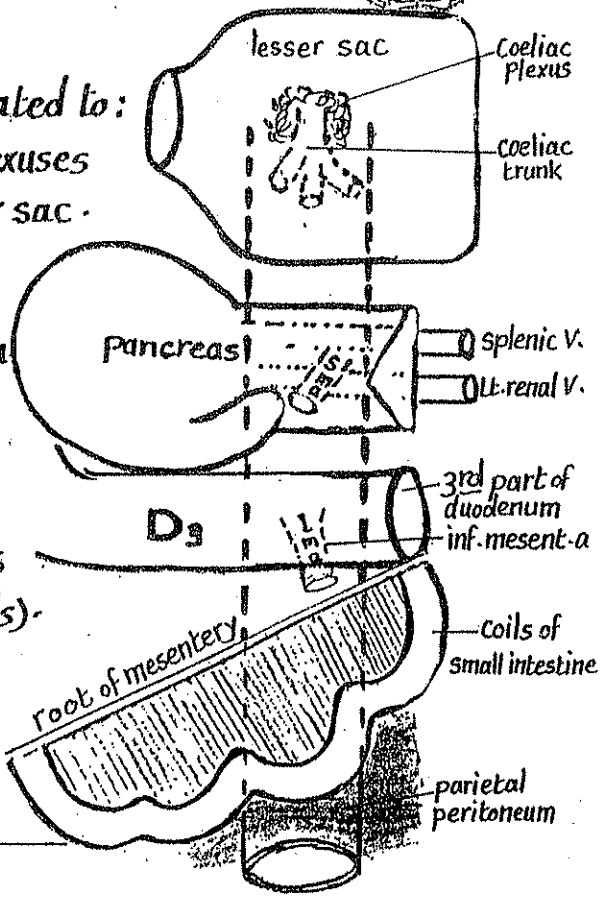
(1) Coeliac trunk & its branches, Coeliac & aortic plexuses separating the abd. aorta from post. wall of lesser sac.

(2) Body of pancreas & 3 structures behind it:
(a) splenic V. (b) Lt. renal V. (c) origin of sup. mesent. a.

(3) 3rd part of duodenum & origin of inferior mesenteric artery

(4) upper part of root of mesentery & its contents (superior mesenteric vessels).

(5) Parietal peritoneum separating it from coils of small intestine.

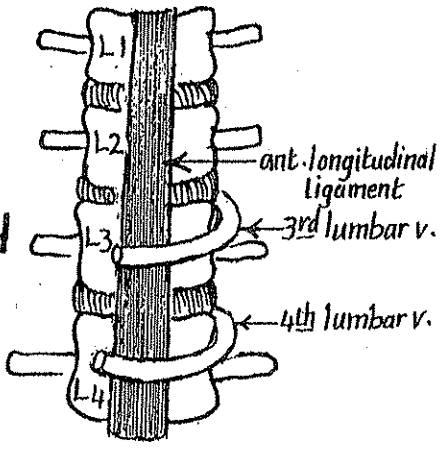


B- **Posteriorly**: it is related to:

(1) the bodies of the upper 4 lumbar vertebrae & intervertebral discs

(2) the anterior longitudinal ligament

(3) the 3rd & 4th lumbar veins as they cross behind the aorta to open into the I.V.C.



Right side relations of the aorta	Left side relations of the aorta

I- in the upper part (above L2) it is related to

(1) Cisterna chyli & thoracic duct

(2) lower part of azygos vein

(3) right Coeliac ganglion

(4) Rt. crus of the diaphragm separating the aorta from I.V.C.

II- In the lower part (below L2):

(5) it is directly related to the I.V.C

(1) Lt. crus of diaphragm

(2) Lt Coeliac ganglion

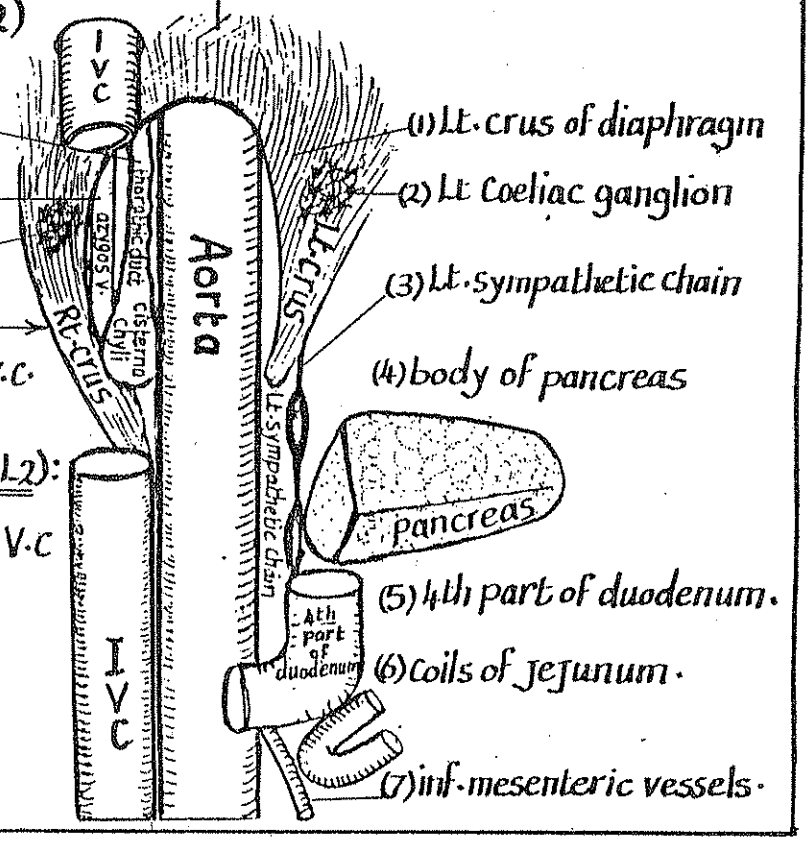
(3) Lt. sympathetic chain

(4) body of pancreas

(5) 4th part of duodenum.

(6) Coils of Jejunum.

(7) inf. mesenteric vessels.



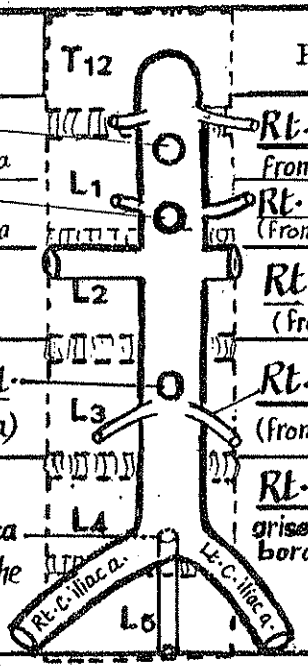
* **Surface anatomy of aorta**: is marked by 2 vertical lines 2 cm apart, extending between:

(1) a point in the median plane one inch above the transpyloric plane.

(2) a point ½ inch below and to the left of the umbilicus (level of L4 vertebra).

* Branches of abdominal aorta

Verebral level	single branches	Paired branches
upper border of L1	(1) Coeliac trunk (From the front of the abd. aorta	Rt. & Lt. inf. phrenic arteries from the sides of the abd. aorta
lower border of L1	(2) Sup. mesenteric a. From the front of the abd. aorta	Rt. & Lt. middle suprarenal aa. (From the sides of abd. aorta
L2	———	Rt. & Lt. renal arteries (From the sides of abd. aorta
L3	Inf. mesenteric a. (From the front of abd. aorta)	Rt. & Lt. gonadal arteries (From anterolateral aspect of aorta
L4	Median sacral a. from the back of abd. aorta (it is the continuation of the aorta in the embryo).	Rt. & Lt. Common iliac aa arise as 2 terminal brs. at lower border of L4.

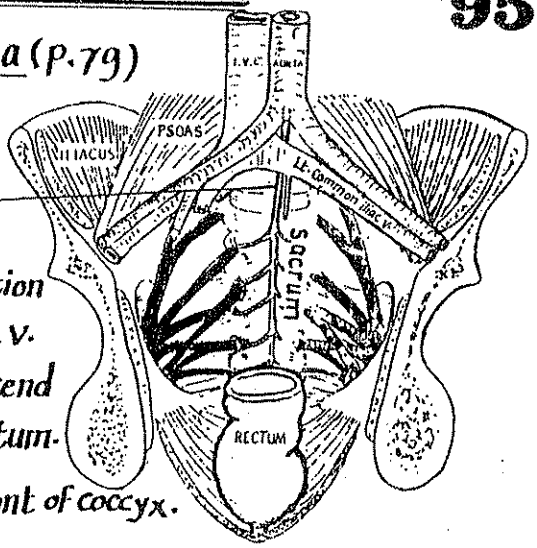


* In addition to the previous branches, the aorta gives 4 pairs of lumbar arteries. Each pair arises from the back of the aorta opposite each vertebral body from L1 to L4.

Details of the branches of the aorta

1- Coeliac trunk : see p. 76. (2) Sup. mesent. a (p. 79)

3- Inferior mesent. a. (page 81).

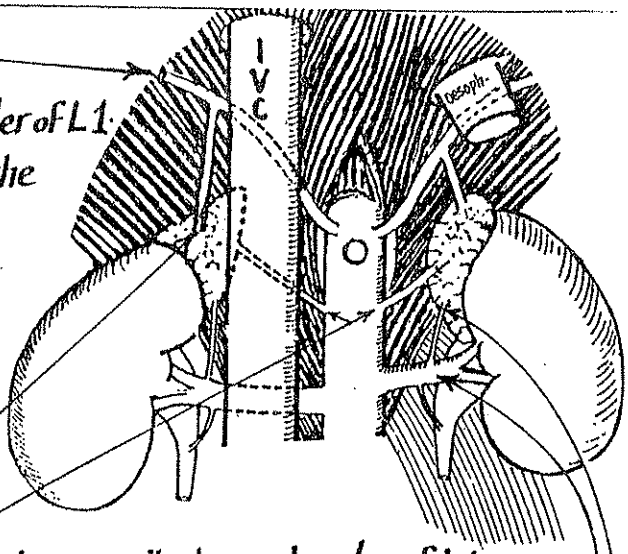


4- Median Sacral artery :

- Arises from the back of aorta just above its bifurcation
- descends infront of L4 & 5 & behind Lt. common iliac v.
- enters the pelvis infront of sacral promontary to descend infront of the middle line of sacrum & behind the rectum.
- it ends in a swelling called glomus coccygeum infront of coccyx.
- Branches : (1) the 5th pair of lumbar arteries.
  (2) twigs to the sacral canal. (3) twigs to the rectum.

N.B : it is accompanied by median sacral v. which ends in Lt. common iliac vein.

5- Inferior phrenic arteries : Rt. & Lt.



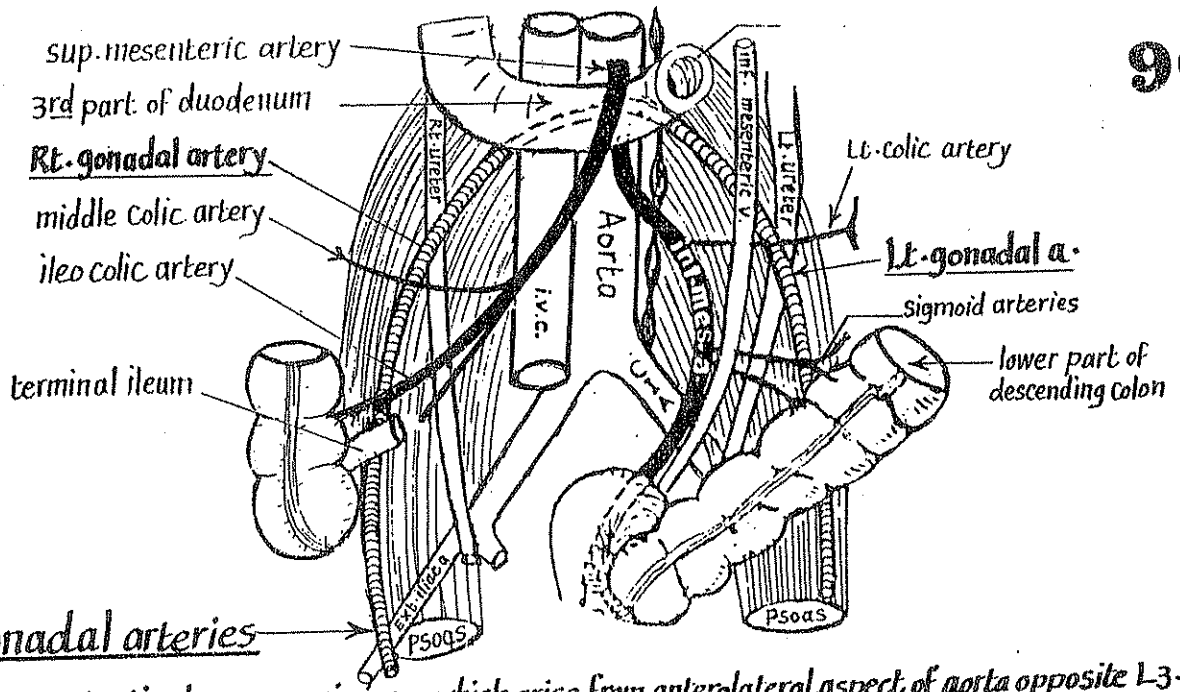
- Origin : From the side of aorta opposite upper border of L1.
- Course : they run upwards, forwards & laterally on the corresponding crus of diaphragm :
  * the Rt. a. passes behind the I.V.C.
  * the Lt. a. passes behind the oesophagus
- each artery ramifies on the under surface of the diaphragm & gives superior suprarenal a.

6- Middle Suprarenal arteries : Rt. & Lt.

- origin : each artery arises from the side of aorta opposite lower border of L1.
- Course : each artery passes laterally on the corresponding crus of diaphragm (the Rt. a. passes behind the I.V.C) & end by supplying the suprarenal gland.

7- Renal arteries : Rt. & Lt. :

- Origin : From the side of abd. aorta opposite L2.
- Course : each artery runs laterally infront of the corresponding crus of diaphragm & psoas major m. to reach the hilum of the kidney, lying infront of the pelvis of the ureter.
  * the Rt. renal a. is longer & passes behind I.V.C, Rt. renal v. & head of pancreas.
  * the Lt. renal a. is shorter & passes behind the Lt. renal v & the body of pancreas.
- Branches : (1) inferior suprarenal artery : to the suprarenal gland
  (2) terminal (lobar) branches (5) to supply the 5 vascular segments of the kidney.
  (3) ureteric brs. to the upper end of the ureter.



(8) Gonadal arteries

* They are testicular or ovarian aa. which arise from anterolateral aspect of aorta opposite L3.

	Right gonadal artery	Left gonadal artery
* Course	they descend downwards & laterally on the post. abd. wall towards the pelvic brim.	
* Posterior relations	it crosses obliquely infront of : (1) I.V.C (2) Rt. psoas major muscle (3) Rt. ureter (4) Rt. genitofemoral n. (5) Rt. external iliac a.	it crosses obliquely infront of : (1) Lt. symp. chain (2) Lt. psoas major (3) Lt. ureter (4) Lt. genitofemoral n. (5) Lt. external iliac artery.
* Anterior relations	(1) 3rd part of duodenum. (2) Rt. colic & ileocolic arteries (3) root of mesentery containing sup. mes. vessels (4) terminal part of ileum.	(1) 4th part of duodenum (2) Lt. colic & sigmoid arteries (3) inferior mesenteric vein. (4) terminal part of descending colon.

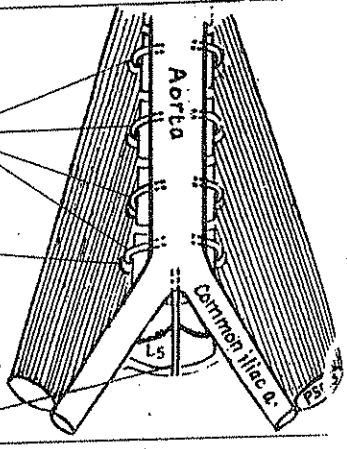
* **Termination**: both testicular & ovarian a. have the same course down to the pelvic inlet then:

- **Testicular a.** : reaches the deep inguinal ring & passes through the inguinal canal among the constituents of the spermatic cord to reach the testis (see page 25).
- **Ovarian a.** : turns medially, crossing the ext. iliac vessels to enter the suspensory lig. of the the ovary to reach the broad lig. then reaches the ovary via the mesovarium (see pelvis).

9- Lumbar arteries :

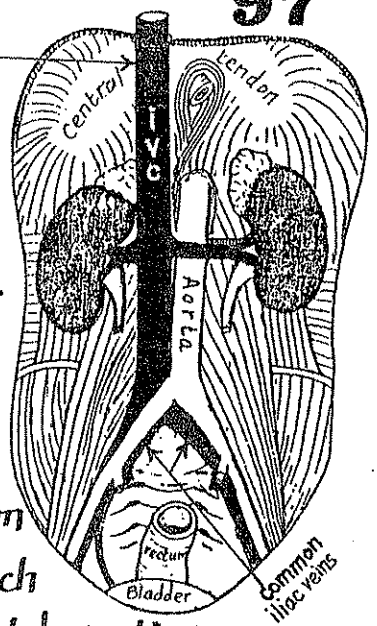
- they are 4 pairs of arteries which arise from the back of abd. aorta
- they run laterally & backwards round the bodies of the upper 4 lumbar deep to the sympathetic trunks & the tendinous arches of psoas major
- then they run behind psoas major & quadratus lumborum muscles (except the 4th lumbar a. which passes infront of the quadratus) to supply: (a) muscles of post. abd. wall & lat. abd. wall (b) spinal cord via radicular brs.

N.B : the 5th pair of lumbar arteries arises from the median sacral a.



10- **Common iliac arteries** : are the 2 terminal branches of aorta (see pelvis for details).

INFERIOR VENA CAVA (I.V.C.)



* **Beginning**: infront of the body of L5 vertebra, slightly to the Rt. of median plane by the union of the Rt. & Lt. Common iliac veins
* **Course**: it ascends in front of the vertebral column (to the Rt. side of abd. aorta) & leaves the abdomen by piercing the central tendon of the diaphragm opposite T8, one inch to the Rt. of median plane.
* **Termination**: in the thorax by piercing the fibrous pericardium & opening into the lower part of Rt. atrium ½ an inch above the diaphragm opposite the 6th Rt. sterno costal junction.

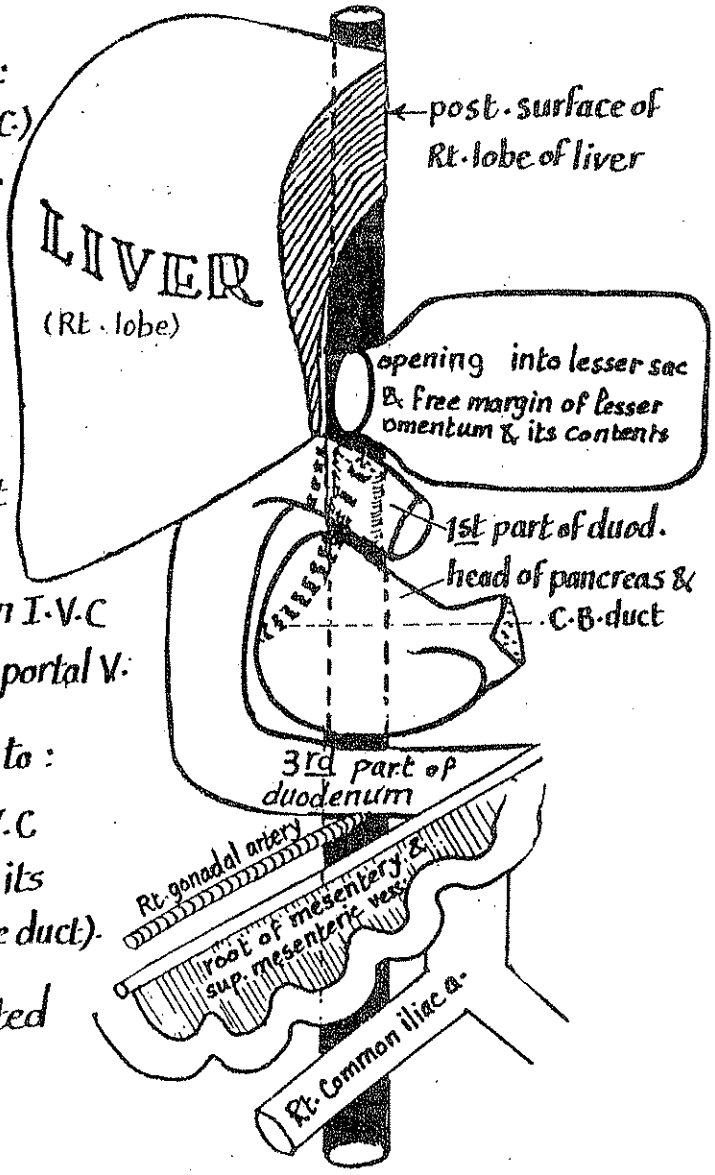
* Relations

I- Anteriorly: (From below upwards):

(A) **Below the duodenum**: it is related to:
(1) Rt. Common iliac a. (at the beginning of I.V.C)
(2) Root of mesentery & sup. mesent. vessels.
(3) Rt. gonadal vessels.

(B) **At the duodenum**: it is related to:
(1) 3rd part of duodenum (separated from I.V.C by the Rt. gonadal a.).
(2) head of pancreas with common bile duct embedded in its post-surface.
(3) 1st part of duodenum (separated from I.V.C by common bile duct, gastroduodenal a. & portal V.

(C) **Above the duodenum**: it is related to:
(1) the epiploic foramen (separating the I.V.C from the free margin of lesser omentum & its contents: portal v., hepatic a. & common bile duct).
(2) post. surface of Rt. lobe of liver (related to the uppermost part of I.V.C).



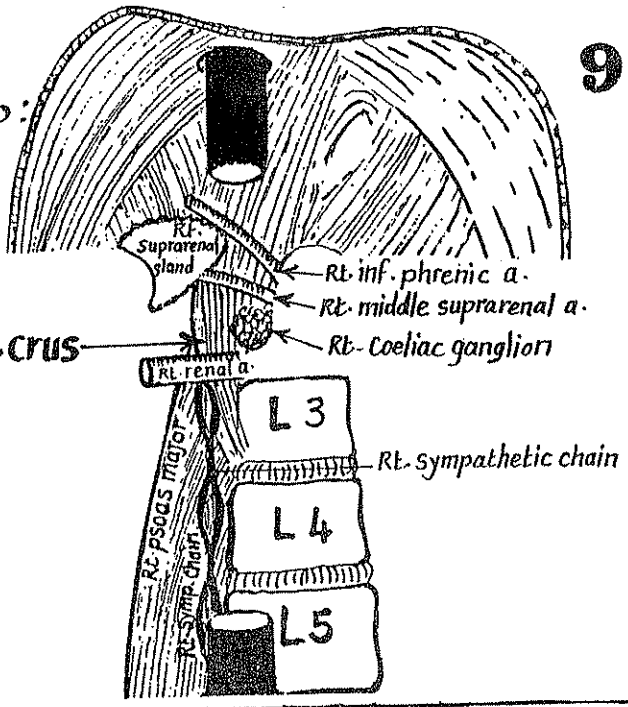
II- Posterior relations:

(A) the lower part of I.V.C is related to:

(1) bodies of the lower 3 lumbar vertebrae
(2) Rt. psoas major muscle
(3) Rt. sympathetic chain

(B) the upper part of I.V.C is related to Rt. crus of diaphragm but separated from it by

(1) Rt. coeliac ganglion
(2) med. part of Rt. suprarenal gland
(3) 3 arteries: (a) Rt. inf. phrenic a.
(b) Rt. middle suprarenal a.
(c) Rt. renal a.

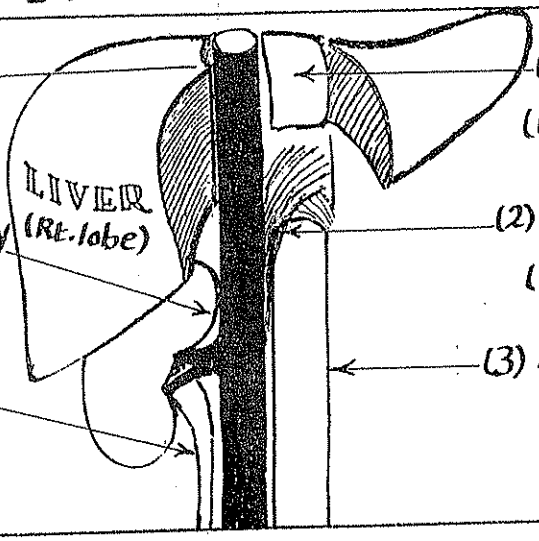


III- Right side relations of I.V.C

(1) Right lobe of liver (in the upper part).
(2) med. border of Rt. kidney (in the middle part).
(3) Right ureter (in the lower part).

IV- Left side relations of I.V.C

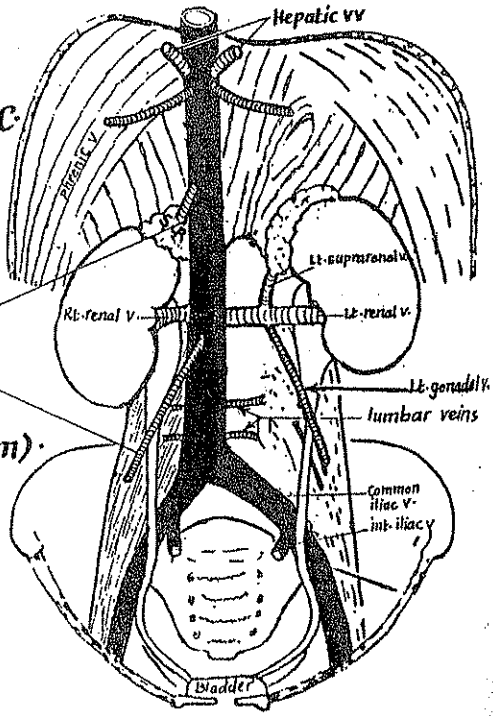
(1) Caudate lobe of liver (in the upper part
(2) Rt. crus of diaphragm (in the middle part
(3) Abdominal aorta (in the lower part)



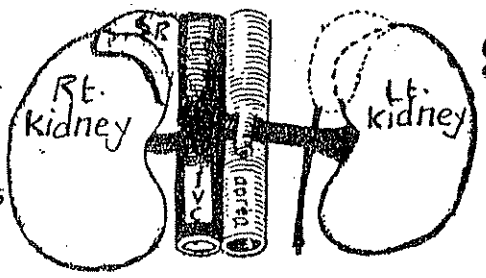
* Tributaries of I.V.C.

(1) 2 Common iliac veins: they unite together forming I.V.C.
(2) 2 pairs of lumbar veins < 3rd lumbar V. (Rt. & Lt.). 4th lumbar V. (Rt. & Lt.).
(3) 2 renal veins (Rt. & Lt.).
(4) 2 Right sided veins — Rt. suprarenal vein; Rt. gonadal Vein
(5) 2 inferior phrenic veins (from inf. surface of diaphragm).
(6) 2 hepatic veins which are very short & open into the I.V.C as it passes in the groove on the posterior surface of the liver.

N.B: Common iliac veins are described in the Pelvis.



Renal veins :



* They are 2 large veins which open into the I.V.C. at Rt. angles.
* The Rt. renal vein is short & lies infront of Rt. psoas major m. & behind the 2nd part of duodenum.
* The Lt. renal vein is 3 times as long as long as the Rt. vein. It passes to the Rt. infront of abd. aorta & behind the body of pancreas, splenic vein & sup. mesenteric a. it receives 2 tributaries : (1) the left gonadal v. (from below) & Lt. supra renal v. (from above).

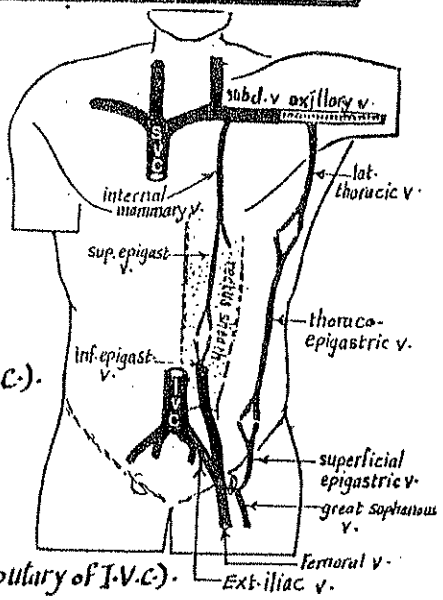
Collateral Venous anastomosis between S.V.C & I.V.C

* **Sites:**

(A) In the ant. abdominal wall:

(1) the thoraco-epigastric v. : is a long vein running in the superficial fascia of the anterolateral wall of the trunk. It connects :

(a) the lat. thoracic v. of axillary v. (drains into the S.V.C.).
(b) the superficial epigastric v. of femoral v. (drains into the I.V.C.).

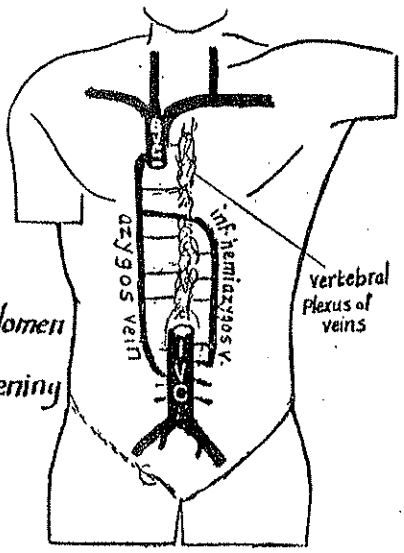


(2) the Superior epigastric v. of internal mammary v. (tributary of S.V.C.) anastomoses inside the rectus sheath with the inf. epigastric v. of the Ext. iliac v. (tributary of I.V.C.).

(B) In the posterior abdominal wall :

(1) the Azygos v. : arises from the back of the I.V.C in the abdomen & ends into the back of the S.V.C. in the thorax (direct connection between S.V.C & I.V.C.).

(2) the Inferior hemiazygos v. : is connected in the abdomen with tributaries of the I.V.C & ends in the thorax by opening into the azygos v. (tributary of the S.V.C.).

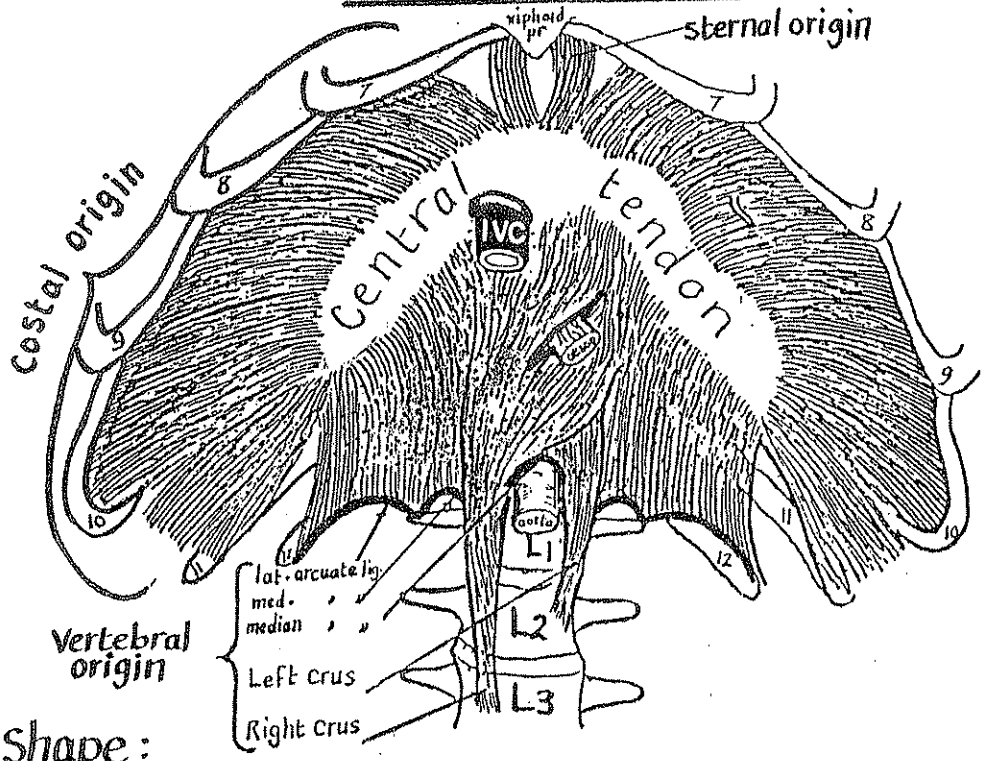


(3) the Vertebral plexus of veins : lies inside the vertebral canal & around the vertebral bodies. It is connected with :

(a) the lumbar veins (tributaries of I.V.C) in the abdomen.
(b) the post. intercostal veins (tributaries of azygos & hemiazygos VV. of S.V.C) in the thorax.

Posterior abdominal wall

1- The diaphragm

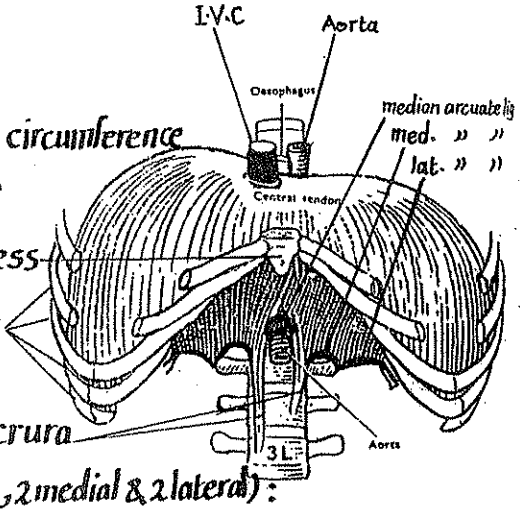


* Nature & Shape :

- it is a large dome shaped fibromuscular partition separating the thorax from the abdomen.
- its upper surface is convex towards the thoracic cavity (forming its floor).
- its lower surface is concave towards the abdominal cavity (forming its roof).
- its right side (called Rt. cupola) bulges higher up than its left side (Lt. cupola) due to the upward bulge of the underlying Rt. lobe of the liver.

* Origin of the diaphragm :

The peripheral part of the diaphragm takes origin from the circumference of the thoracic outlet. The origin is divided into 3 parts:



(1) **Sternal origin** : by 2 slips from the back of xiphoid process.

(2) **Costal origin** : by slips from inner surfaces of lower 6 ribs & their costal cartilages.

(3) **Vertebral Origin** : by 2 muscular bands called Rt. & Lt. crura & 5 tendinous arches called arcuate ligaments (one median, 2 medial & 2 lateral) :

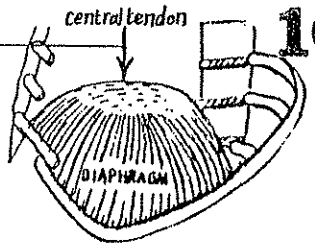
(a) Rt. crus : arises from the front of the upper 3 lumbar vertebrae.

(b) Lt. crus : " " " " " " upper 2 lumbar vertebrae.

(c) median arcuate lig : a tendinous arch connecting the 2 crura infront of the aorta.

(d) each medial arcuate lig. is a tendinous arch connecting the crus with tip of tr. process of L1

(e) each lateral arcuate lig. " " " " " the tip of tr. process of L1 with the last rib.



*Insertion of the diaphragm:

the fibres of the sternal, costal & vertebral origin converge to be inserted into a crescentic-shaped central tendon which is more anterior than posterior in position

*Nerve Supply:

(A) Motor: phrenic nerves (Rt. & Lt.) are the sole motor nerves to the diaphragm

(B) Sensory: (1) phrenic nerves are sensory to the central part.
(2) lower 6 thoracic nerves are sensory to the peripheral parts.

*Arterial Supply:

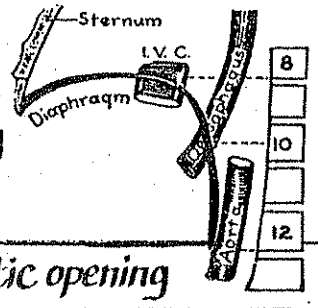
(1) phrenic branches of thoracic & abdominal aorta.
(2) pericardiacophrenic & musculophrenic branches of internal mammary a.
(3) lower 3 posterior intercostal arteries.

*Actions of the diaphragm:

(1) It is the main muscle of inspiration: on contraction it descends leading to increase in the vertical diameter of the thorax thus air is sucked in.
(2) it increases the intra abdominal pressure to give additional power to all expulsive actions e.g vomiting, micturition, defaecation & labour.
(3) the Rt. crus of diaphragm has a sphincteric action on the lower end of oesophagus (P. 38).
(4) it helps the venous return to the heart by: (a) increasing the intra-abdominal pressure (b) decreasing the intra thoracic pressure (c) widening of the vena caval opening.

*Major foramina of the diaphragm (Voice Of America)

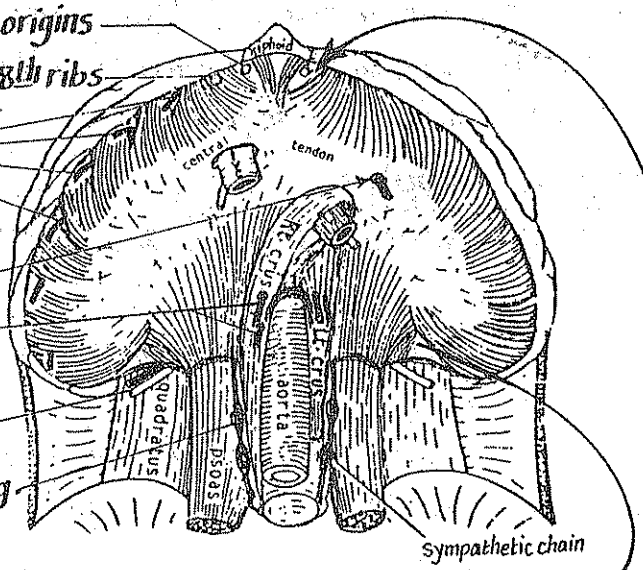
- Vena caval opening
- Oesophageal opening
- Aortic opening



Opening	Vena caval opening	Oesophageal opening	Aortic opening
Vertebral level	T 8	T 10	T 12
Position & its significance	1" to the Rt. of median plane, piercing the central tendon of diaph. to be always patent to help venous return	1" to the Lt. of median plane piercing the Rt crus of diaphragm to act as sphincter for the lower end of oesophagus	in the median plane, behind the median arcuate lig. of the diaphragm which protects the aorta from contractions of the diaphragm.
Structures passing	(1) the I.V.C. (2) Rt. phrenic nerve. (3) lymphatics from the liver to mediastinal LNs.	(1) oesophagus (2) Ant. & post. Vagal trunks (3) oesophageal br. of Lt gastric artery	(1) Aorta (2) thoracic duct (3) azygos vein. (4) lymphatics from the thorax to the cisterna chyli

*Minor foramina of the diaphragm & structures passing through

(1) Sup. epigastric a. : passes between sternal & costal origins
(2) musculophrenic a. : passes between slips from 7th & 8th ribs
(3) the lower 5 intercostal nerves : pass between the slips of costal origin.
(4) Lt. phrenic n. pierces the Lt. cupola of diaphragm
(5) the greater & lesser splanchnic nerves : pierc the corresponding crus of the diaphragm.
(6) Subcostal n. & vessels pass behind lat. arcuate lig.
(7) Sympathetic chain passes behind med. arcuate lig
(8) inf. hemiazygos v. pierces the Lt. crus



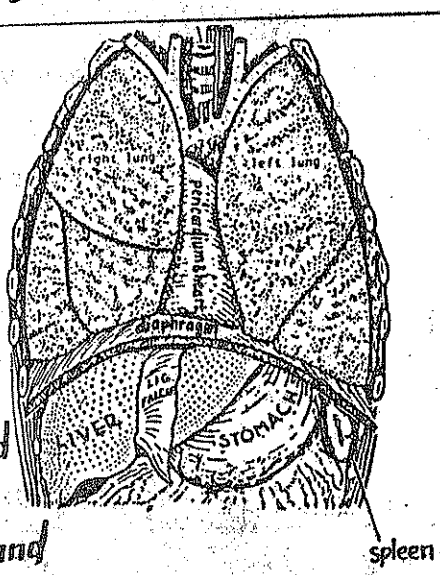
N.B: (1) the Vertebro costal Δ: is a triangular gap between the vertebral & costal origins which is wider on the Lt. side. Abdominal contents may herniate through this gap into the thorax (Congenital diaphragmatic hernia of Bockdalek).

(2) the Sternocostal Δ: is a small triangular gap between the sternal & costal origins It may lead to herniation of an intestinal loop into thorax (Congenital parasternal hernia

*Relations of the diaphragm:

(A) upper surface:
(1) its central tendon: is related to the pericardium & heart
(2) the Rt. cupola: is related to Rt. pleura & base of Rt. lung
(3) the Lt. cupola: " " " Lt. pleura & base of Lt. lung

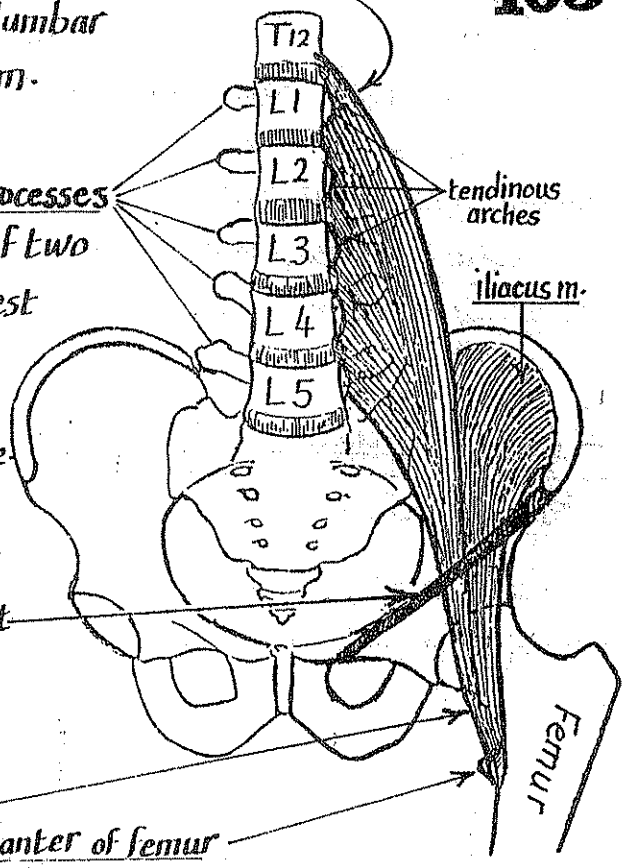
(B) Lower Surface:
(1) its Rt. side is related to: Rt. lobe of the liver; Rt. kidney & Rt. suprarenal gland
(2) its Lt. side is related to: Lt. lobe of the liver; Lt. kidney & Lt. suprarenal gland; stomach & spleen.



*Applied anatomy:

(1) Hiccough is the result of spasmodic contraction of the diaphragm.
(2) irritation of the diaphragm causes referred pain in the shoulder because the phrenic n. (sensory to diaphragm) & the supraclavicular nn. (sensory to the shoulder) have the same root value ($C_{3,4}$).
(3) injury of one phrenic n. leads to paradoxical diaphragmatic movements i-e the normal cupola descends down while the paralysed cupola moves up with each inspiration
(4) acquired hiatus hernia: widening of the oesophageal opening of diaphragm → herniation of stomach into the thorax (commonest type of internal hernias).

2- Psoas major muscle



* It is a long fusiform m. lying on either side of the lumbar vertebral column & along the side of the pelvic brim.

* **Origin:**

(1) from the ant. surfaces of the 5 lumbar transvers processes
(2) by 5 slips, each of which arises from the bodies of two adjacent vertebrae & the disc inbetween (the highest slip arises from the 12th thoracic vertebra).
(3) from the 4 tendinous arches which bridge over the lumbar vessels on the sides of lumbar vertebrae.

* **Course:**

the lower part of the muscle leaves the abdomen by passing behind the lat. part of the inguinal ligament closely related to the iliacus muscle.

* **Insertion:**

together with iliacus, it forms the iliopsoas tendon which is inserted into ant. & med. aspects of lesser trochanter of femur

* **Nerve Supply:** ventral rami of L 1, 2, 3.

* **Action:**

1- acting from above: it is a powerful flexor of the thigh & also rotates it medially
2- acting from below: it produces flexion of the pelvis over the thigh (e.g when rising from the recumbent position.
3- one psoas: produces lateral flexion of the vertebral column towards its side.

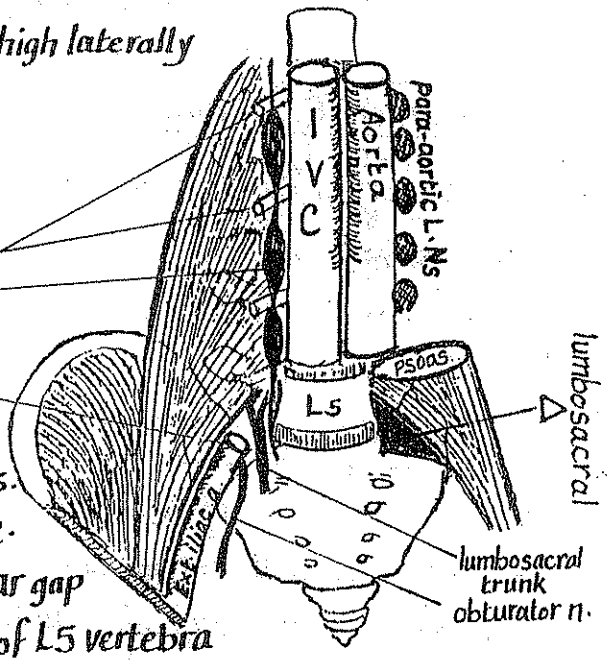
N.B: in fracture neck of femur, the muscle rotates the thigh laterally

Relations

I- Medially: it is related to

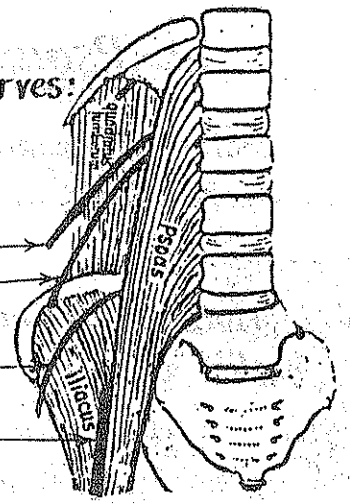
(1) bodies of lumbar vertebrae & lumbar vessels
(2) sympathetic chain
(3) external iliac vessels (along the pelvic brim)
(4) I.V.C overlapping the Rt. psoas major m.
(5) aorta & paraaortic L.Ns: anteromedial to Lt. psoas.
(6) obturator n. & lumbosacral trunk & iliolumbar a.

in the lumbosacral Δ which is a triangular gap between: (a) med. border of psoas major (b) body of L5 vertebra (c) the ala of sacrum.



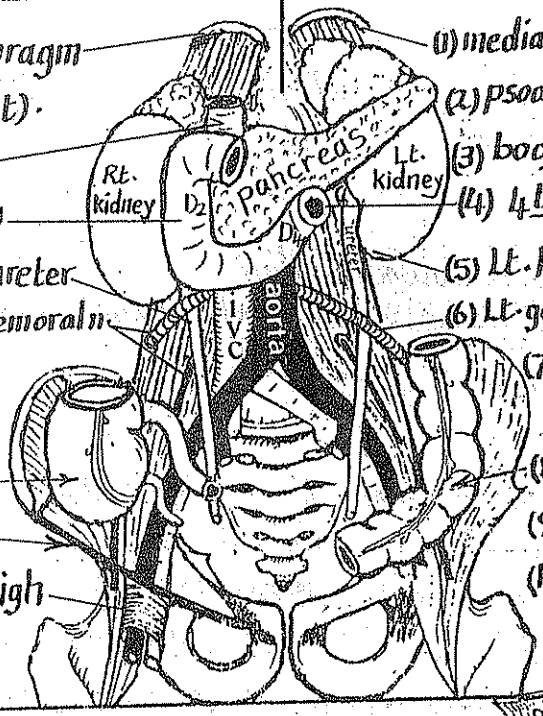
II- Laterally (along its lat. border): 2 muscles & 4 nerves:

(1) quadratus lumborum muscle (in the upper part).
(2) iliacus muscle (in the lower part).
(3) iliohypogastric nerve
(4) ilioinguinal nerve
(5) lateral cutaneous nerve of thigh
(6) femoral nerve



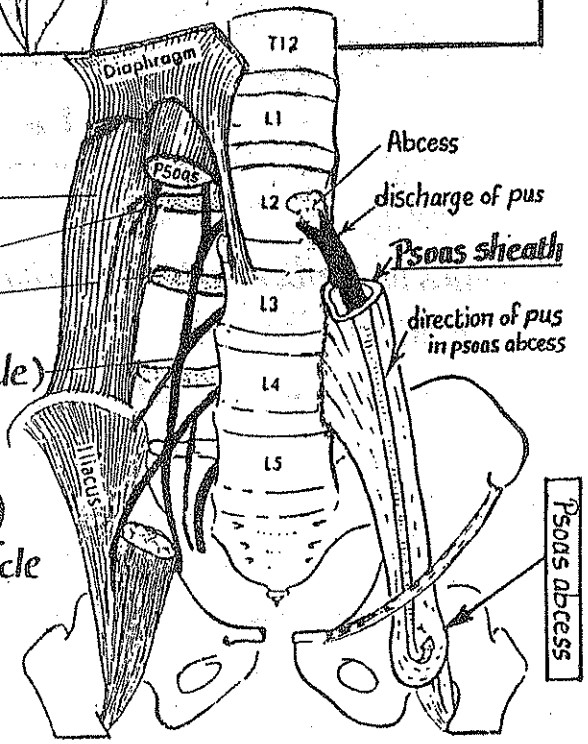
III- Anterolateral relations:

Rt. psoas major muscle	Lt. psoas major muscle
(1) medial arcuate lig. of diaphragm	(1) medial arcuate lig. of diaphragm
(2) psoas minor m. (if present).	(2) psoas minor m. (if present)
(3) inferior vena cava	(3) body of pancreas
(4) 2nd part of duodenum	(4) 4th part of duodenum
(5) Rt. kidney, renal vessels & ureter	(5) Lt. kidney, renal vessels & ureter
(6) Rt. gonadal vessels & genitofemoral n.	(6) Lt. gonadal vessels & genitofemoral n.
(7) sup. mesenteric a. & its Rt. colic & ileocolic branches	(7) inf. mesenteric a. and its upper & lower Lt. colic branches.
(8) terminal ileum & caecum	(8) descending colon.
(9) Rt. inguinal ligament.	(9) Lt. inguinal ligament.
(10) Rt. femoral sheath in the thigh	(10) Lt. femoral sheath.



IV- Posterior relations:

(1) medial border of quadratus lumborum muscle
(2) lumbar arteries.
(3) lumbar transverse processes.
(4) lumbar plexus (embedded in the post. part of the muscle)
(5) capsule of the hip joint (in the thigh).



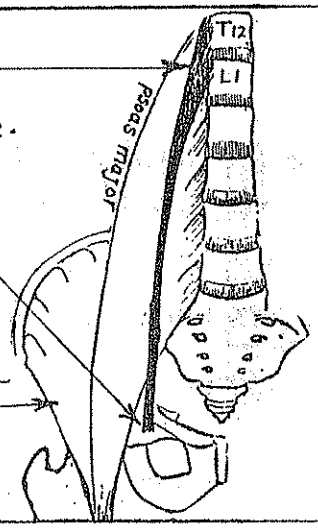
Psoas fascia (sheath)

* It is a fascial sheath enveloping the psoas major muscle throughout its whole length down to its insertion.
- Above: it is thickened to form the medial arcuate lig.
- medially: it is attached to the lumbar vertebrae.

- laterally: it blends with the fasciae covering quadratus lumborum & iliacus muscles.

* **Applied anatomy: Psoas abcess:**
pus arising from tuberculous abcess of lumbar spreads to the psoas sheath & tracks downwards within the sheath to reach the front of the thigh just below the inguinal ligament.

3- Psoas minor muscle

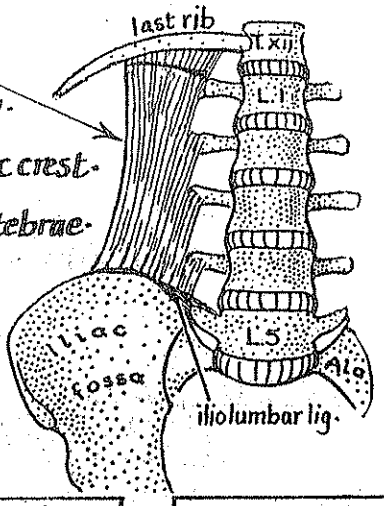


* It is a long slender muscle lying infront of psoas major in 60% of people.
* **Origin:** from the sides of T12 & L1 vertebrae & the disc inbetween.
* **Insertion:** by a long flat tendon into the iliopubic eminence of hip bone
* **Nerve supply:** by branch from L1 nerve.
* **Action:** weak flexor of the trunk.

4- ILIACUS

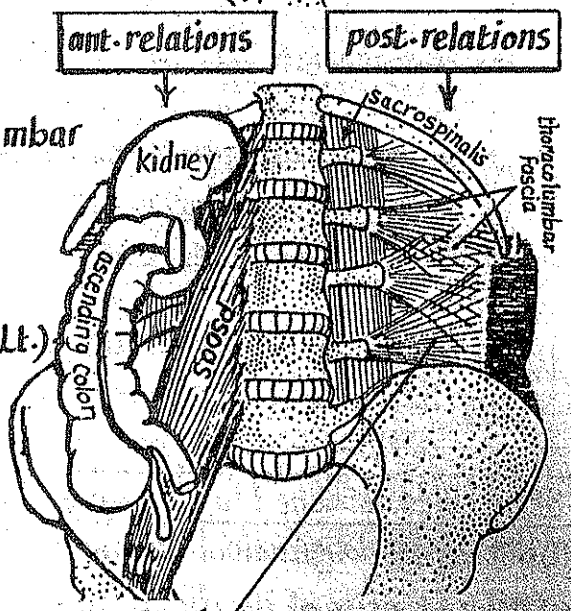
(See lower limb)

5- Quadratus lumborum muscle



* It is a qudrilateral muscle lying posterolateral to psoas major m.
* **Origin:** from ilio-lumbar lig. & the adjoining 5 cm of inner lip of iliac crest.
* **Insertion:** (1) tips of transverse processes of upper 4 lumbar vertebrae.
  (2) med. ½ of the lower border of the last rib.
* **Nerve Supply:** brs. from the 12th thoracic & upper 4 lumbar nn.
* **Action:** (1) lateral flexor of the vertebral column.
  (2) muscle of inspiration by fixing the last rib during the contraction of the diaphragm.

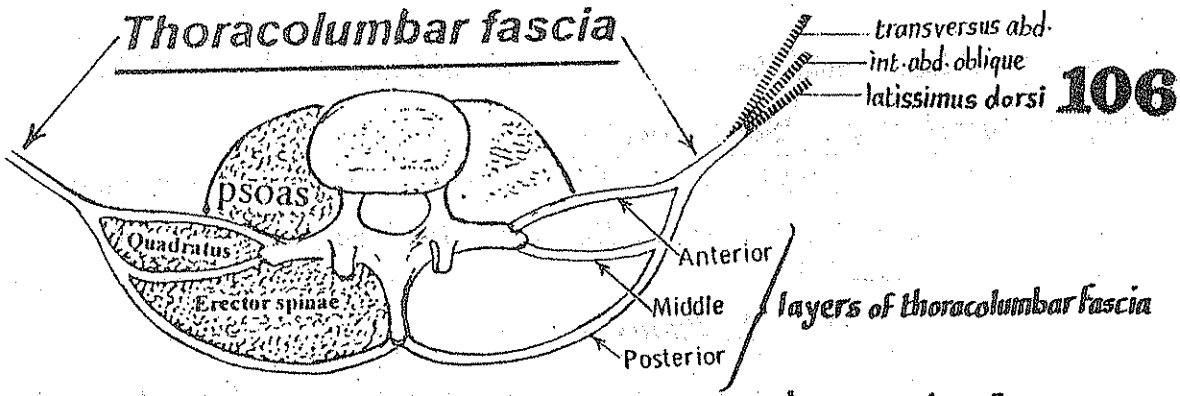
* **Relations:**



I- **Anteriorly:** it is covered by the ant. layer of thoracolumbar fascia & is related to:
(1) lateral part of psoas major muscle.
(2) the kidney.
(3) Colon (ascending on the Rt. side & descending on the Lt.)
(4) it is crossed by the following nerves:
- (a) subcostal nerve
- (b) iliohypogastric n.
- (c) ilioinguinal n.

} from above downwards.

II- **Posteriorly:** it is covered by middle layer of thoracolumbar fascia & is related to sacrospinalis muscle.



* It is a strong sheet of deep fascia which covers & envelops most of the deep muscles of the back & binds them to the vertebral column.
* Extent: it extends from the sacrum below to the neck above but it is well developed in the lumbar region.
* Layers: in the lumbar region it differentiates into 3 layers:

(1) anterior layer: covers the ant. surface of quadratus lumborum m. & is attached to the ant. aspect of the transverse processes of the lumbar vertebrae.

(2) middle layer: covers the post. surface of quadratus lumborum (separating it from erector spinae m.) & is attached to the tips of the transverse process of lumbar vertebrae.

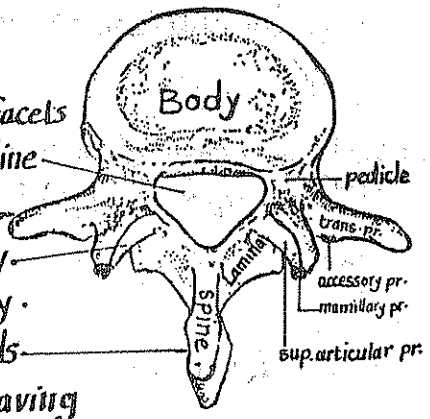
(3) posterior layer: covers the post. surface of erector spinae (sacrospinalis) m. & is attached medially to the spines of the lumbar vertebrae.

N.B: (1) the post. layer is the strongest one & extends up to the neck & down to the sacrum.
(2) at the lat. border of quadratus lumborum the ant. & middle layers fuse together & this fusion gives origin to 3 muscles: (a) transversus abdominis
(b) internal abd. oblique
(c) latissimus dorsi m.

LUMBAR VERTEBRAE

* Characteristics:

(1) the body: large in size, kidney-shaped & has no costal facets
(2) the vertebral foramen is small in size & triangular in outline
(3) the transverse process is flat & elongated
(4) the sup. articular facets are concave & directed medially.
(5) " inf. " " " convex & " laterally.
(6) the spine is quadrilateral & projects directly backwards

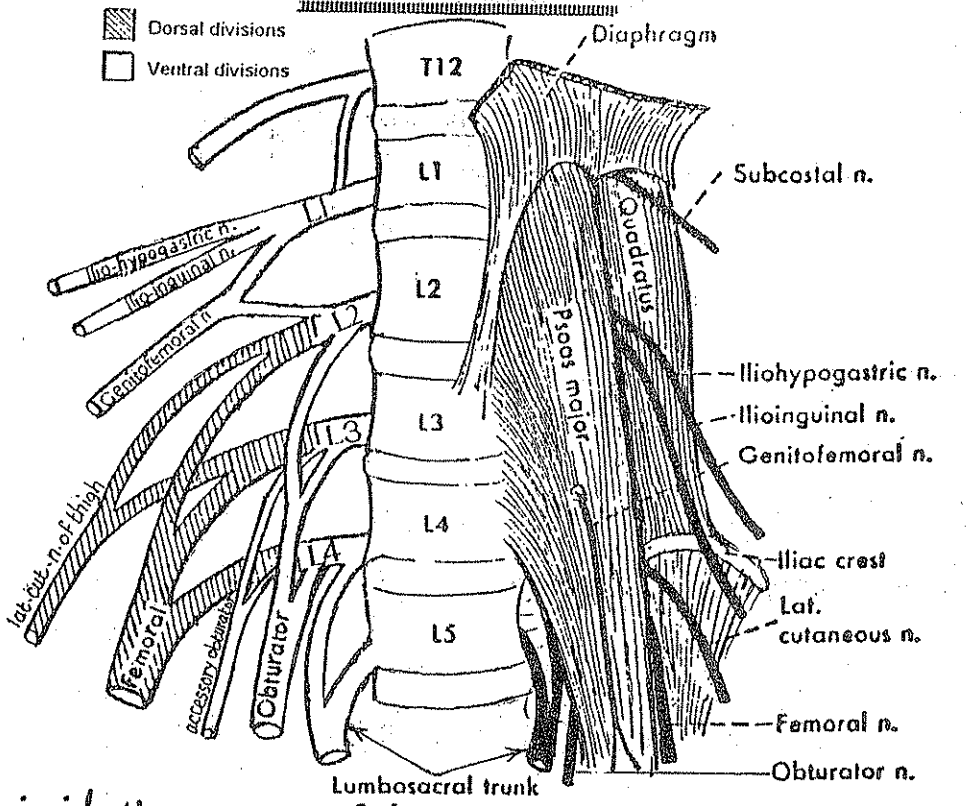


N.B: the 5th lumbar vertebra differs from the rest in having a thick strong transverse process which is attached to the pedicle.

Structures attached to the bodies of vertebrae	Structures attached to the transverse processes
(1) ant. & post. longitudinal ligaments.	(1) psoas major & quadratus lumborum muscles
(2) Rt. & Lt. crus of the diaphragm.	(2) lat. & med. arcuate ligs. of the diaphragm
(3) psoas major & minor muscles	(3) iliolumbar lig. (to L5 only)
(4) lumbar intervertebral discs.	(4) lumbar fascia & sacrospinalis muscle

1- Lumbar plexus

Formation & branches of lumbar plexus



Exit of the branches from psoas major m.

*Site: it lies inside the post-part of the substance of psoas major m. in the abdomen

*Formation: by the ant-ry rami of the upper 4 lumbar nerves (L1, 2, 3, 4). Each of which (except L1) divides into ant-(ventral) & post-(dorsal) divisions.

*Branches of the plexus:

Large branches	Small branches	Distribution of the roots of the plexus
(1) Femoral n. from post-divisions of L2,3,4	(3) iliohypogastric (L1)	L1 gives: Iliohypogastric n.; Ilioinguinal n.; 1st root of genitofemoral n.
(2) Obturator n. from ant-divisions of L2,3,4	(4) ilioinguinal (L1)	L2 gives: 2nd root of genitofemoral n.; 1st root of lat-cut-n-of thigh; 1st root of obturator n.; 1st root of femoral n.
	(5) genitofemoral (L1,2)	L3 gives: 2nd root of lat-cut-n-of thigh; 2nd root of obturator n.; 2nd root of femoral n.
	(6) lat-cut-n. of thigh (post-divisions of L2,3	L4 gives: 3rd root of obturator n.; 3rd root of femoral n.; upper root of lumbosacral trunk
(7) Accessory obturator n. is frequently present and arises from the ventral divisions of L3 & L4		

*Exit of the branches from the psoas major muscle:

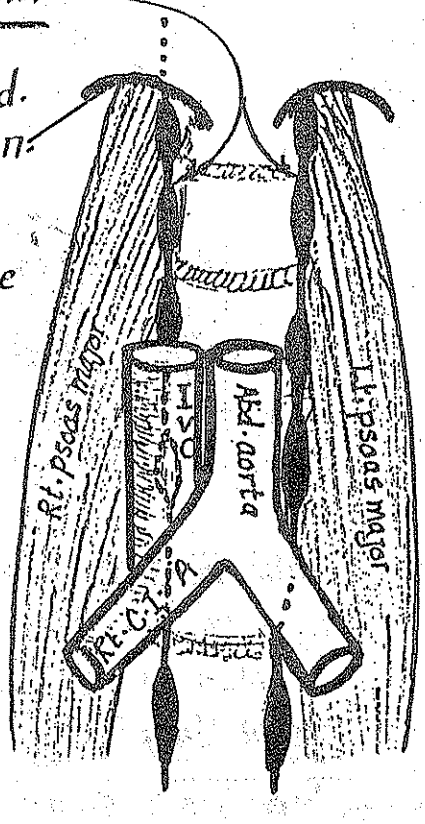
(1) obturator n.
(2) accessory obturator n. } emerge from the medial border of psoas major.
(3) lumbosacral trunk.

(4) Iliohypogastric n.
(5) Ilio inguinal nerve
(6) lat. cut. n. of thigh
(7) Femoral nerve
} emerge from the lat. border of psoas major

(8) Genitofemoral nerve: emerges from the ant. surface of psoas major.

N.B: for details of the branches of the lumbar plexus: See lower limb.

2- Lumbar part of the Sympathetic chain



* **Begins & enters the abdomen**: by passing behind the med. arcuate lig. of the diaphragm.

* **Course & relations**:

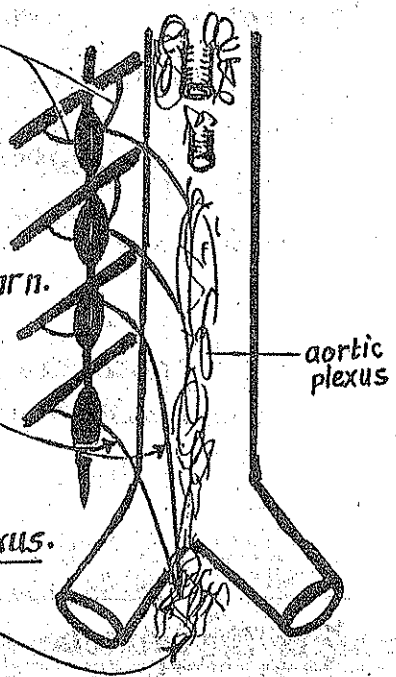
- each symp. chain descends vertically downwards on the side of lumbar vertebrae along the med. border of psoas major muscle.
- the Rt. chain: lies behind the I.V.C.
- the Lt. chain: lies on the Lt. side of the abd. aorta.

* **Each chain leaves the abdomen & enters the pelvis** by passing behind the common iliac vessels to continue as the pelvic part of the symp. chain.

* **Ganglia**: each chain contains 4 ganglia

* **Branches**:

(A) **Rami communicantes** (lat. branches):
- each ganglion of the 4 lumbar ganglia gives off a grey ramus communicans (postganglionic) to the corresponding lumbar nerve.
- each of the 1st & 2nd ganglia receives a white ramus communicans (preganglionic) from the corresponding lumbar n.



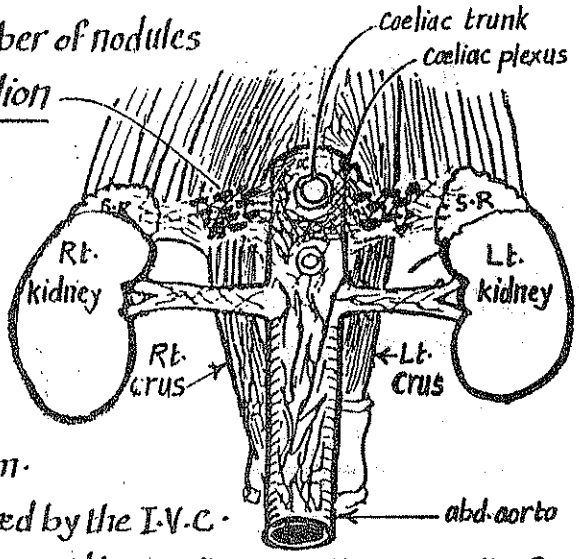
(B) **Lumbar Splanchnic nerves** (med. branches):
they are 4 nerves (one from each ganglion):
- the upper 2 splanchnic nn. join the aortic plexus.
- the lower 2 splanchnic nn. join the sup. hypogastric plexus.

(C) **Vascular branches**:
they surround the aorta, its 2 iliac divisions & accompany their branches to the viscera.

3-Autonomic plexuses of abdomen

1- the Coeliac plexus

* the **Coeliac plexus** : is a plexus of autonomic n. fibres lying on the front of abd. aorta & crura of diaphragm around the coeliac trunk
* the plexus ends laterally on each side in a number of nodules which collectively constitute the **Coeliac ganglion**



(A) The Coeliac ganglia (Rt. & Lt.)

* **Site** : one on each side of the Coeliac trunk.
* **Size** : it is the largest ganglion in the body.
* **relations** : - medially : coeliac trunk.
  - laterally : supra renal gland.
  - posteriorly : crus of the diaphragm.
  - anteriorly : the Rt. ganglion is covered by the I.V.C. while the Lt. ganglion is covered by peritoneum of post. wall of lesser sac.
* **Afferent nerves**: each ganglion receives the greater & lesser splanchnic nerves which arise from the thoracic part of the symp. chain.
* **Efferent branches** : - the nerves which arise from the 2 ganglia form the Coeliac plexus.
  - each ganglion gives also many branches to the corresponding suprarenal gland.

(B) Coeliac plexus

* **site**: around the coeliac trunk.
* **Formation**: it is formed of :

(a) sympathetic post-ganglionic fibres from the Coeliac ganglia.

(b) parasymp. preganglionic fibres from both Vagi (mainly the Rt. vagus).

* **Branches**: (A) Coeliac plexus gives off 2ry plexuses around the following arteries:

(1) the Coeliac trunk & its 3 branches (hepatic, splenic & Lt. gastric arteries).

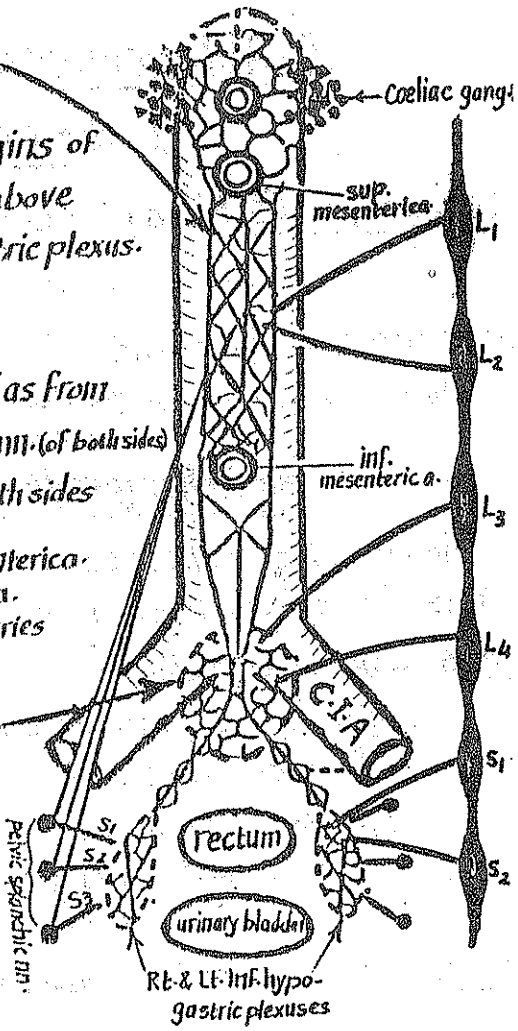
(2) Sup. mesenteric a.

(3) the renal & gonadal arteries

(B) it also gives branches to:

(1) the suprarenal gland (2) the aortic (intermesenteric) plexus.

II- Aortic (intermesenteric) plexus:



* Site: it surrounds the abd. aorta between the origins of the sup. & inf. mesenteric arteries. It is continuous above with the cœliac plexus & below with the sup. hypogastric plexus.
* Formation: it is formed of:
  (a) Sympathetic fibres: from the cœliac plexus as well as from the 1st & 2nd lumbar splanchnic nn. (of both sides)
  (b) parasymp. fibres: from the pelvic splanchnic nn. of both sides ($S_{2,3,4}$)
* Branches: (a) it gives 2ry plexuses around: inf. mesenterica, gonadal a., iliac arteries
  (b) branches to the sup. hypogastric plexus.

III- Superior hypogastric plexus:

* Site: just below aortic bifurcation (infront of L5). it is continuous above with the aortic plexus & divides below into Rt. & Lt. divisions which join the Rt. & Lt. Inf. hypogastric plexuses respectively
* Formation: it is formed of:
  (a) sympathetic fibres from: (1) the aortic plexus (2) the 3rd & 4th lumbar splanchic nerves (of both sides).
  (b) parasymp. fibres: from the pelvic splanchnic nerves of both sides ($S_{2,3,4}$).
* Branches:
  (1) it divides inferiorly to Rt. & Lt. hypogastric nerves which descend into the pelvis to form the Rt. & Lt. inf. hypogastric plexuses.
  (2) it also gives branches to the ureteric, gonadal & common iliac plexuses.

IV inf. hypogastric plexuses:

* Site: there are 2 plexuses (Rt. & Lt.) lying in the extraperitoneal tissue of the pelvis on each side of the rectum & base of the urinary bladder (or cervix of uterus).
* Formation: it is formed of
  (a) sympathetic fibres from: (1) the sup. hypogastric plexus (2) the upper 2 sacral sympathetic ganglia.
  (b) parasymp. fibres from the pelvic splanchnic nerves ($S_{2,3,4}$).
* Branches: each plexus gives 2ry plexuses which surround the arteries to reach pelvic viscera:
  (1) middle rectal plexus: to the rectum.
  (2) Vesical plexus: to the urinary bladder, seminal vesicles & vas deferens.
  (3) prostatic " : to the prostate & penis
  (4) uterovaginal plexus: to the uterus & vagina (in the female).

Abdominal Lymph Nodes

I-Aortic L·Ns·

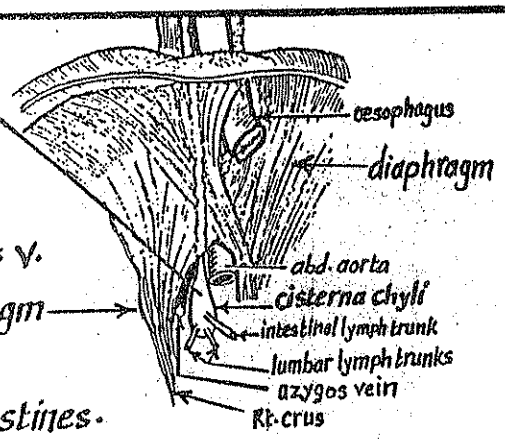
* These are the main L·Ns of the abdomen.
* According to their relations to the abd·aorta they are classified into: preaortic L·Ns, Lat·aortic L·Ns, retroaortic L·Ns

group	Subgroups	Afferent lymphatics come from:	Efferent lymphatics
(A) preaortic L·Ns. in front of the abd. aorta	(1) Coeliac L·Ns: around the coeliac trunk	(1) gastric L·Ns around the stomach. (2) hepatic L·Ns in the lesser omentum. (3) pancreaticosplenic L·Ns along splenica.	their efferent lymphatics form the intestinal lymph trunk which opens in the cisterna chyli.
	(2) sup. mesenteric L·Ns & (3) inf. mesenteric L·Ns around the origins of sup. & inf. mesenteric aa.	(1) mesenteric L·Ns draining jejunum & ileum. (2) Colic L·Ns (along colic arteries) draining the large intestine. (3) pararectal L·Ns alongside the rectum	
(B) para aortic L·Ns on each side of the abd. aorta	Rt & Lt. groups on the Rt & Lt. sides of abdominal aorta	their afferents accompany lat & dorsal branches of abd. aorta & drain: (1) Kidneys & abd. part of the Ureters. (2) the gonads, Fallopian tubes & upper part of body of uterus (in females) (3) com. iliac L·Ns (draining pelvic wall & organs).	their efferent lymphatics form the Rt. & Lt. lumbar lymph trunks which open into the cisterna chyli
(C) Retroaortic L·Ns behind abd. aorta	they are regarded as outlying members of lat. aortic L·Ns.	have no particular area of drainage	

II-Regional L·Ns

they are described previously with abdominal organs & peritoneal folds.

The Cisterna chyli



* It is a spindle shaped lymph sac about 2" long
* it lies infront of the upper 2 lumbar vertebrae between 2 structures: abd. aorta (to the Lt.) & azygos V. (to the Rt.) & is overlaped by the Rt. crus of diaphragm
* It receives the following tributaries:
  (1) Intestinal lymph trunk: draining the lymph from the intestines.
  (2) Rt. & Lt. lumbar lymph trunks: draining the lower limbs & all the abdomen except the upper surface of the liver.
* Its upper end tapers forming the thoracic duct.

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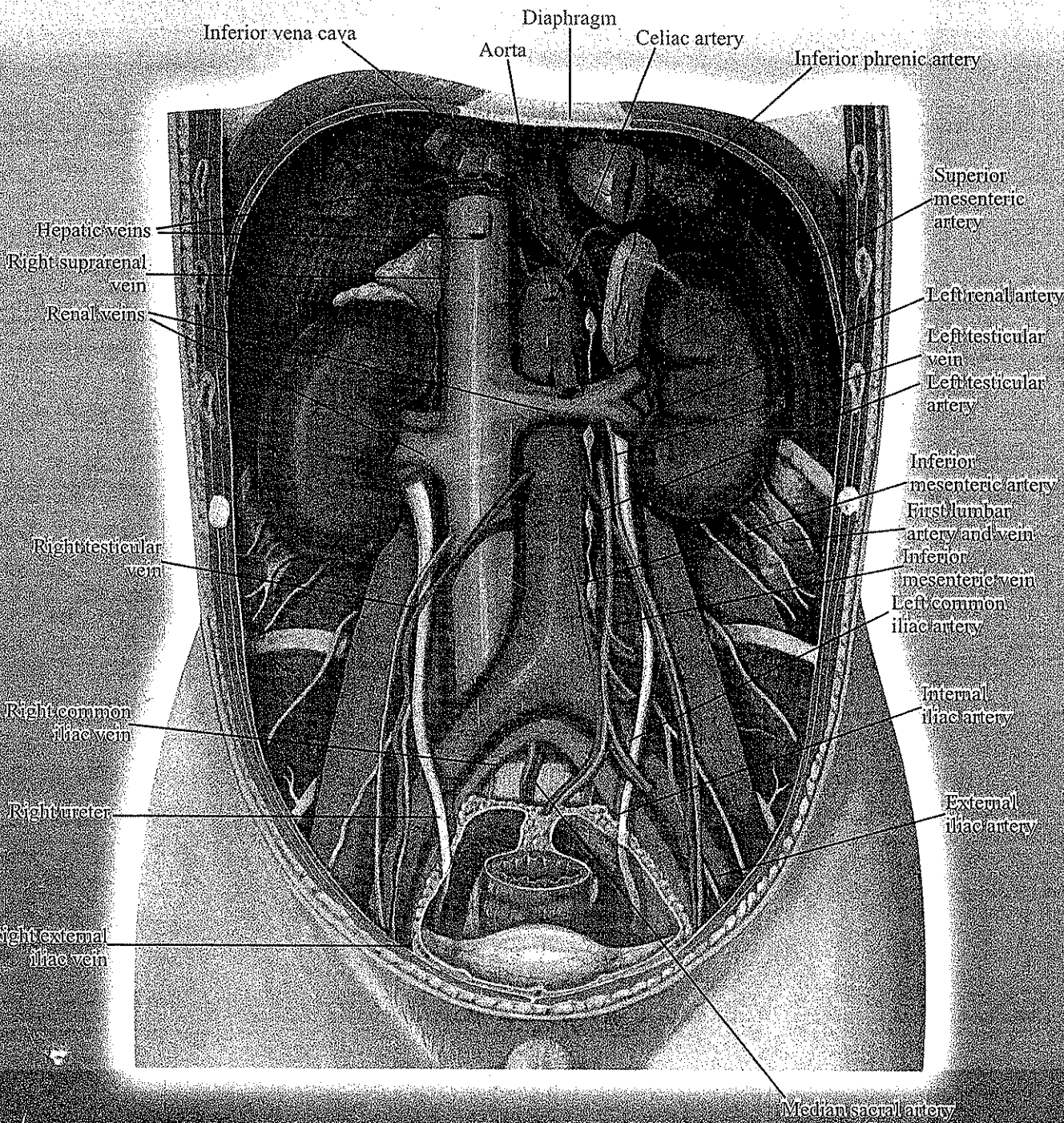
Inferior vena cava
Diaphragm
Aorta
Celiac artery
Inferior phrenic artery
Superior mesenteric artery
Hepatic veins
Right suprarenal vein
Renal veins
Left renal artery
Left testicular vein
Left testicular artery
Inferior mesenteric artery
First lumbar artery and vein
Right testicular vein
Inferior mesenteric vein
Left common iliac artery
Internal iliac artery
Right common iliac vein
Right ureter
External iliac artery
Right external iliac vein
Median sacral artery